

MODEL ENGINEERS'

WORKSHOP

THE NEW, PRACTICAL HOBBY MAGAZINE

**MAKE THIS
USEFUL
TREPANNING
TOOL ...
Plus PULL-OUT
DRAWINGS**



**FREE
INSIDE!**

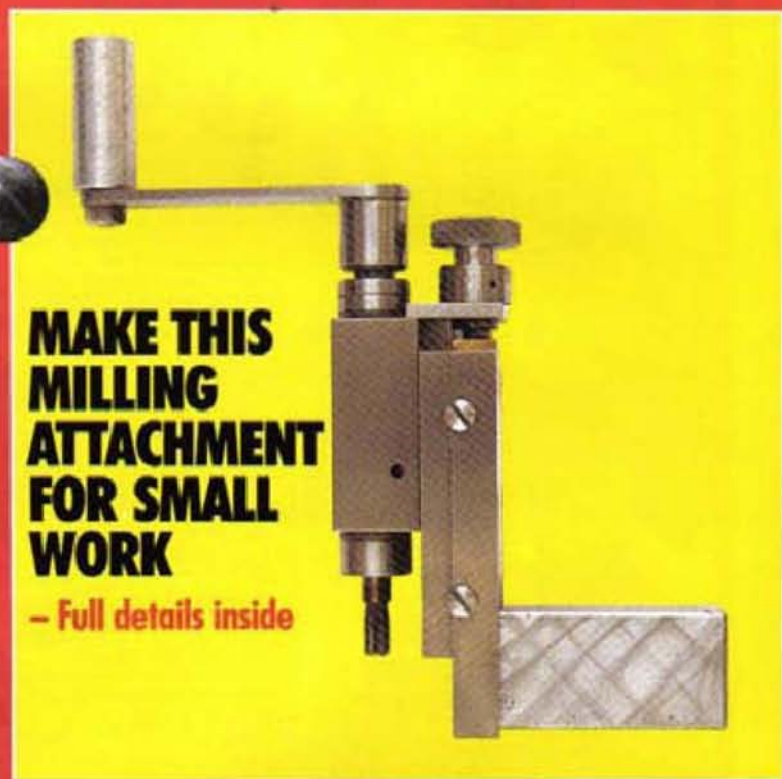
For this
swing-clear
rear tool
post



**HINTS AND TIPS • SMALL PIECE STORAGE
• ELIMINATING BACKLASH
• KNURLING TOOL • SILVER SOLDERING**

**MAKE THIS
MILLING
ATTACHMENT
FOR SMALL
WORK**

– Full details inside



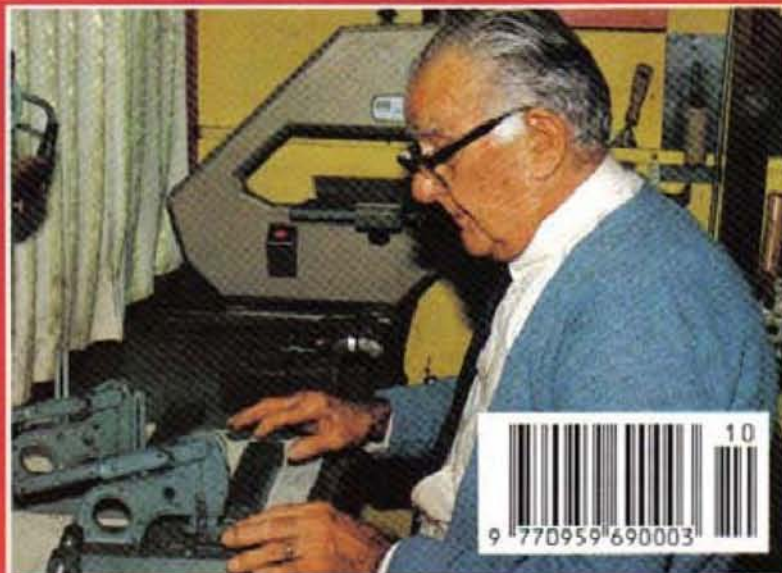
MAKE ALL THESE:

A variable lead threading device

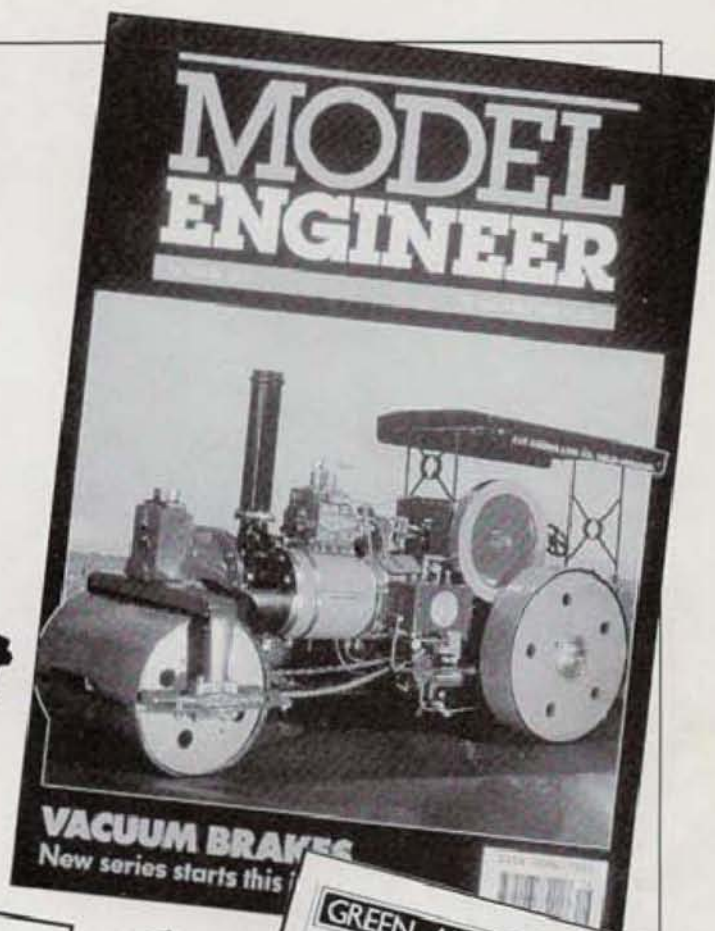
Low-voltage workshop lighting

Your own wood lathe

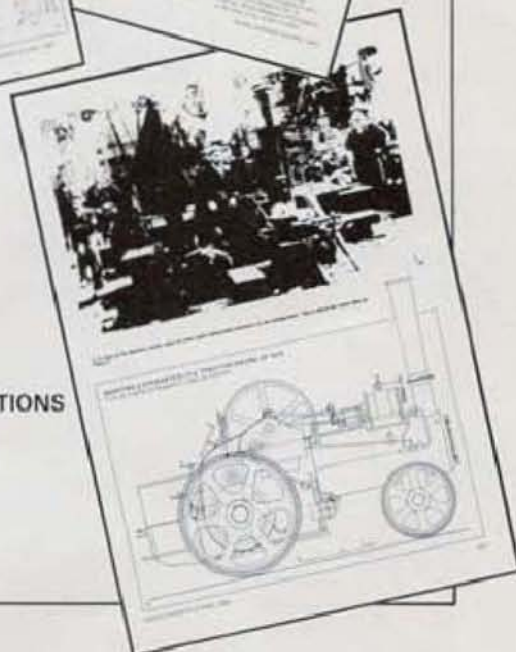
A bandsaw from fabrications



**SOMETHING
TO LOOK
FORWARD
TO...**
...every fortnight



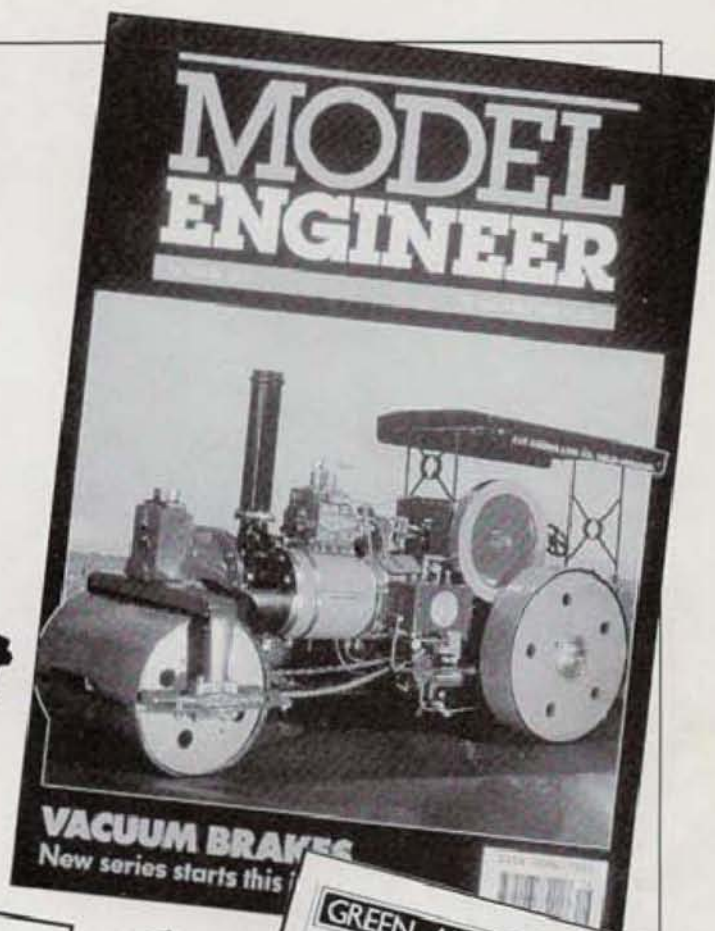
There's something to anticipate twice every month in fascinating Model Engineer magazine! Whether your interests lie in live steam locomotive models, traction engines, internal combustion motors or stationary engines, world famous M.E. will inspire, instruct, advise and encourage. Model Engineer is published on the first and third Fridays each month and costs just £1.40 from all good newsagents; alternatively, you may care to ensure your regular copies through an annual subscription - a mere £33.60 for UK readers (overseas rates and airmail details on request).



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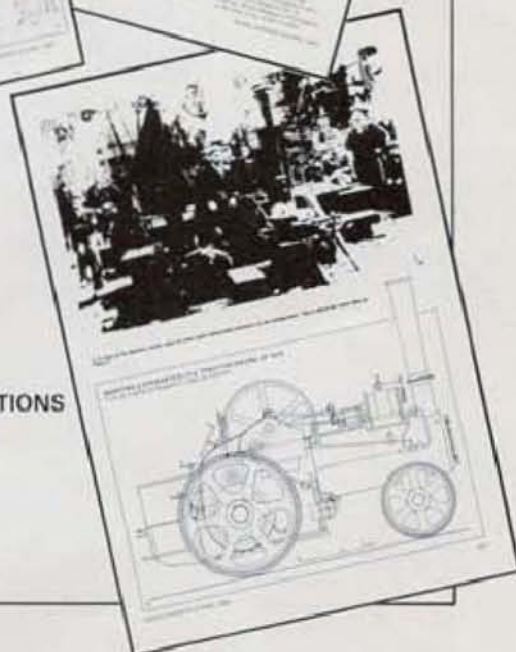
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Stan Bray

ON THE EDITOR'S BENCH

Well, here we are with the second issue of *Model Engineers' Workshop*, already nicknamed 'MEW'. The first issue has obviously been very well received and I am pleased to say that we can again offer readers a good mix of workshop-related articles in this second number. As before, we have tried to cater for the whole spectrum, from the beginner to the advanced enthusiast.

I must start by thanking all the many hundreds of readers who either wrote letters or completed our survey form. Some actually did both! Everyone seems to be very pleased with what we are offering in the way of content and some of the comments have been very flattering indeed – modesty alone prevents them being printed! I would like to have written personally to all those who made contact but this, of course, is just not possible. I have made a note of quite a large number of queries that were included and in due course a reply will be sent, but with such very large numbers there will be some delay...

A start has been made on analysing the forms but this will take some time; as this is being written, forms are still arriving! The results so far have given a good indication of the way readers would like to see the magazine develop and the type of articles that are wanted. We will in due course be able to satisfy virtually everyone's wishes, of that I am sure. It also gave some idea of the facilities which readers have and will enable articles to be targeted towards those facilities. With many thousands of readers, the range of interests is, of course, very wide indeed but that in itself will create no great problem. We do, after all, have by far the greatest number of pages of any magazine on model engineering and

so can cater for a whole range of subjects. In particular, there have been numerous pleas not to forget the beginner, and also to cater for the owner of the smaller lathe. This will also be done.

But please do not expect your favourite subject to come up immediately; the preparation of articles takes a great deal of time. We rely on contributions from readers and other interested parties, and what is not supplied is sorted out in the editor's workshop. Unfortunately, there is no magic formula for conjuring the particular article out of thin air and so the different subjects will have to be taken step by step. Already, we have a number of people working on different projects that are related to items that were requested in the survey, so all looks well for the future.

Perhaps a word about how the magazine is organised would not go amiss at this stage. As editor and, supposedly, having retired some while ago (!) I work from my home, paying visits to the publishers as need be in the interests of the magazine. When all the copy is completed it is sent to Argus Specialist Publications and from there to the printers. This does mean that the delay in letters being received at Argus House and the reply being sent can be considerable, so if writing, please allow plenty of time for a reply. One plea I would make is for the inclusion of a stamped addressed envelope if a reply is required to a letter. I am, naturally, only too pleased to reply to all correspondence, if possible.

That is enough from me, as readers will be wanting to get on with some of the many projects we have for you this time. Once again, very many thanks to all of you for the kind remarks; it is most gratifying.

IN OUR NEXT ISSUE!



As you enjoy this Autumn issue of MEW and get started on the numerous projects, planning is already well in hand for issue number three, our Winter 1990 collection of designs, ideas and advice. We'll start next time with a quick change gear-box for the lathe (photo above). Although requiring some gear-cutting the gear-box is not too difficult to make and has the advantage of being very compact, thus avoiding the more usual large extrusion on the lathe bed.

Then there's a useful running centre design (photo below) for those who would like to make this useful lathe accessory, plus all about parting off; the subject is dealt with in depth with some useful ideas on how to go about it and the construction of tools and tool-holders.

Next comes a height adjustable tool post; just one of several designs we have in hand, this useful item will cater for lathes of all sizes and saves that interminable packing required to get tools to the exact centre height of the lathe.

For the beginner we discuss datums, what they are and how to select them. Marking out accuracy depends to a large extent on a good



datum and this article shows how it is achieved. Next come micrometer adjustable stops. We have already dealt with one design of lathe stop, and here, Les May shows us how to get a great deal more accuracy by making them adjustable to fine limits. The article is also suitable for making stops on a milling machine.

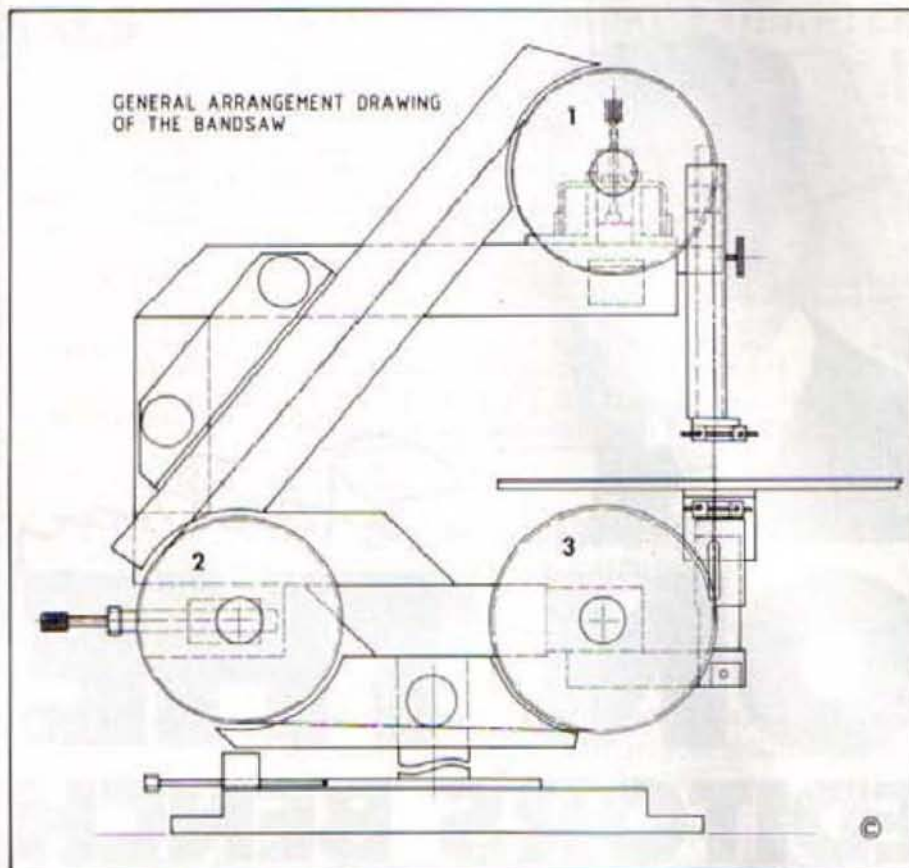
In addition, there will be a visit to a home workshop, trade news and several more constructional articles which should prove of immense interest to our readers. Plus, of course, lots more! Ask your newsagent to reserve you a copy.

ON SALE DECEMBER 14th!

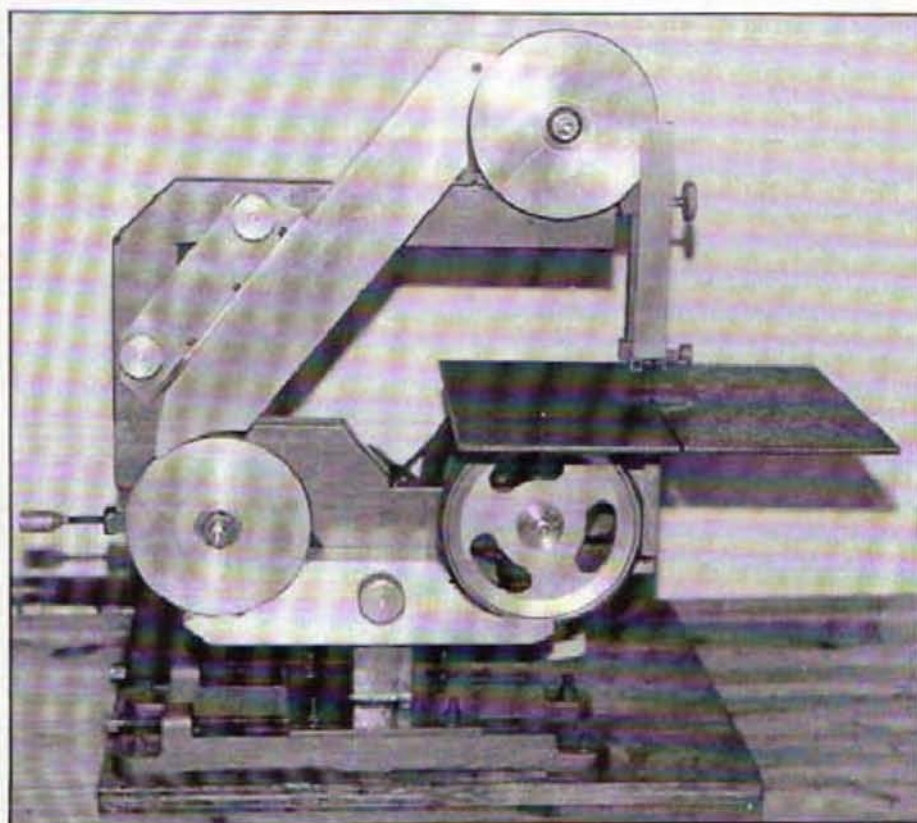
Contents may be changed

Bandsaws are very useful pieces of equipment. Some of the cheap ones that are available leave a lot to be desired when it comes to the heavier tasks, although it must be said that the model engineer may expect more from them than they were designed for, and generally for lighter work they will prove satisfactory. Raymond Wood decided that the one he borrowed was not to the standard that he required and set about making his own very robust machine. The saw is of the three wheel type, made from stock material without castings and although some welding was involved other methods such as riveting with angle brackets could be adopted.

I am making John Haining's Road Roller and getting along nicely, but after struggling for hours to cut thick sheet steel with a hacksaw I decided there must be better ways of going about things, particularly as I wanted to cut down the construction time as much as possible. The obvious answer was a bandsaw!



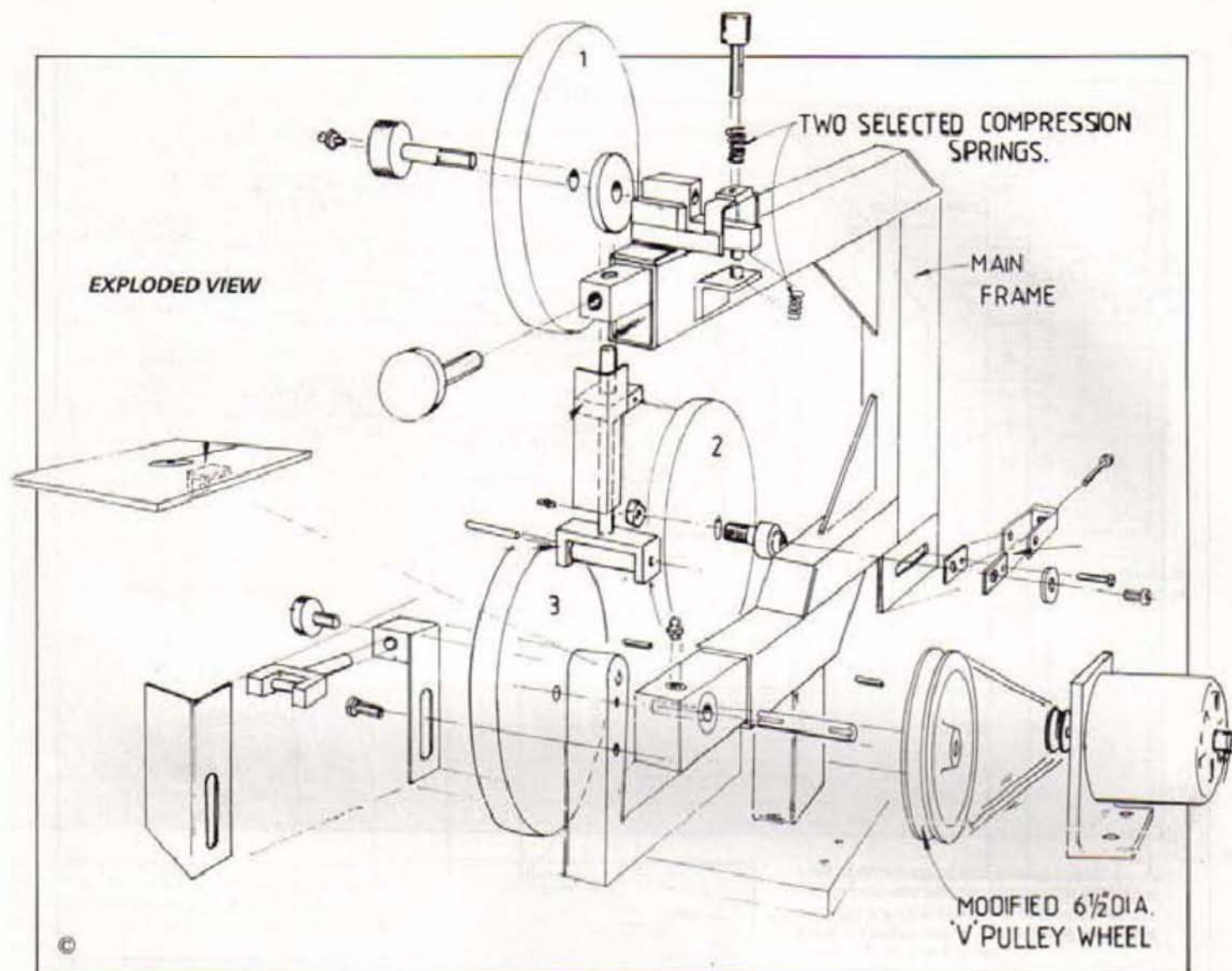
MAKE A THREE WHEEL BANDSAW



First of all, I borrowed a commercially made one from my father-in-law and was quite disappointed with the results. This was due to the construction of the machine being on the light side, no doubt to keep the price down. It certainly was not going to be suitable for the work I intended to do. I needed something substantial, but not too large, whilst hopefully not costing too much either. I decided that if I wanted to buy such a machine it would cost a great deal of money as even the lightweight ones are around £140 each. I therefore decided that the only way I could hope to get what I required was to build one from scratch and, if possible, use material available in the workshop or easily obtained.

The saw is of the three-pulley type and for convenience of reference I will call the pulleys by numbers. Looking at the general arrangement drawing, number one is at the top. Here we will find the axis adjuster. Number two is at the left-hand side, and adjacent to the blade tensioner, whilst number three is at the right and the axle on which it runs also contains the drive pulley.

General view of the finished bandsaw; the photograph clearly illustrates the neat appearance of the machine as well as its very solid construction.



The main frame

For the main frame I used 2 in. $\times$ 1 in. box section mild steel of fourteen gauge thickness. This was cut to suitable lengths and welded together, the welded edges chamfered in order to ensure good penetration of the weld. After welding, the metal was ground flush to give a neat finish. The frame has three forty-five degree angles and for these I cut the angles but left the outer edges, which were then folded back and welded down, making a neat job, and not leaving untidy gaps.

Two gussets were fitted in one corner to give both strength and rigidity to the frame. Any distortion caused by the welding was straightened afterwards – potential builders should note that the completed frame must be square and straight.

There are two solid inserts in the ends of the frame one at the top and one at the bottom. The top one carried the blade guide and was made from a piece of mild steel $\frac{3}{4}$ in. $\times$ 2 $\frac{1}{2}$ in. long. It fits tightly into the frame and is welded into position, after being checked for accuracy.

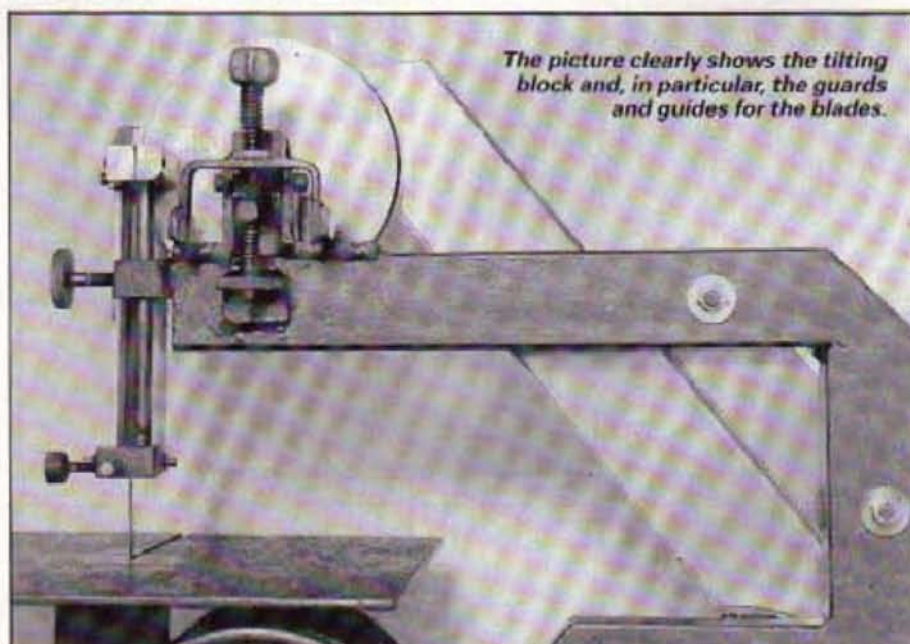
The second insert carries the drive pulley and spindle and is fitted with a bronze bearing bush. This insert, too, is from mild steel and like the first was welded into position after checking for accuracy.

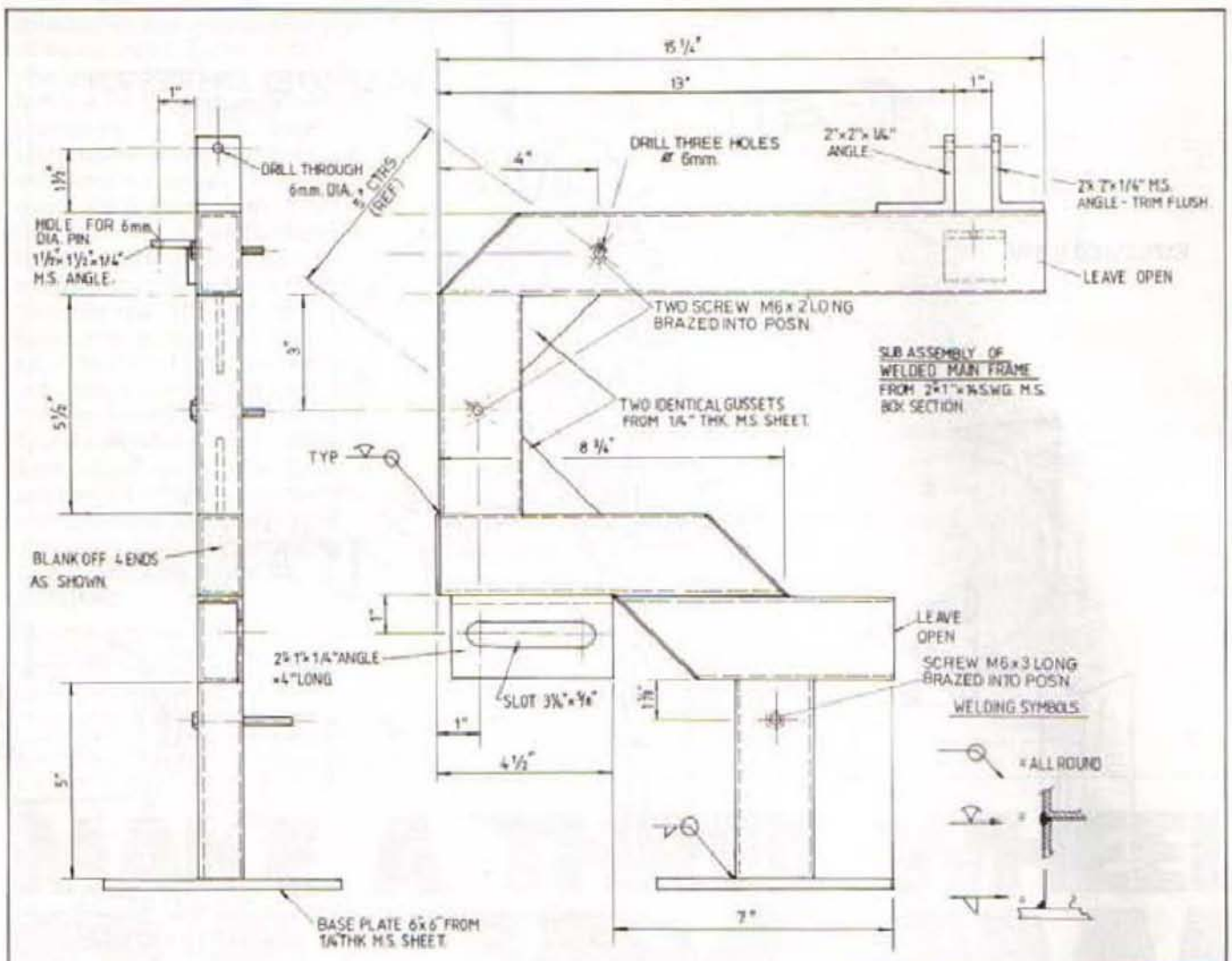
Also on the frame is a slotted angle bracket which accepts the blade tensioner. I used a piece of 2 in. $\times$ 1 in. $\times$ $\frac{3}{4}$ in. angle for

this. A $\frac{1}{2}$ in. slot was cut in it before once again welding it to the frame.

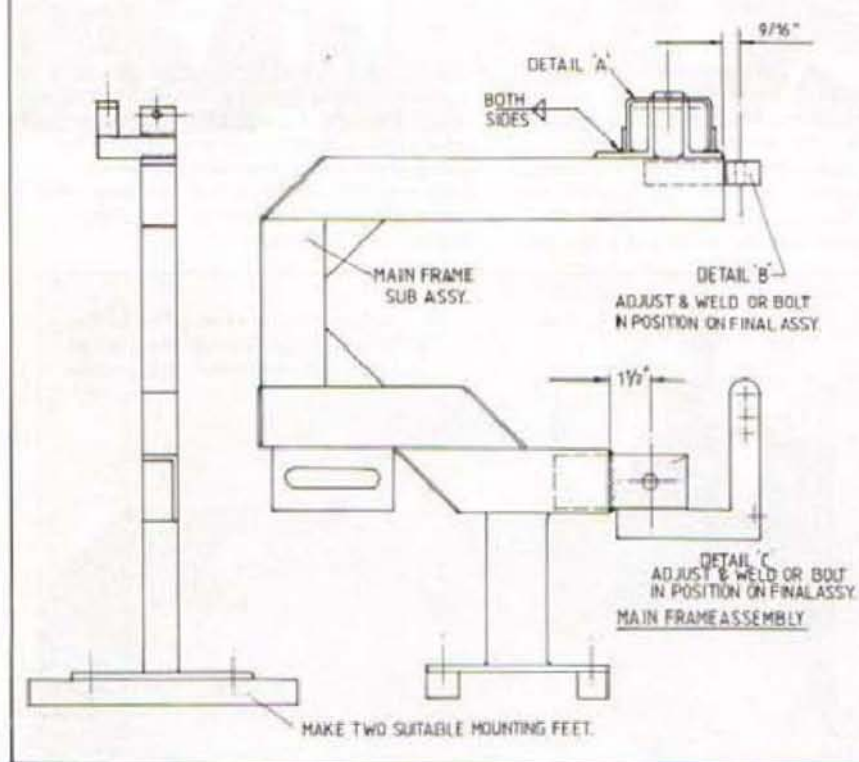
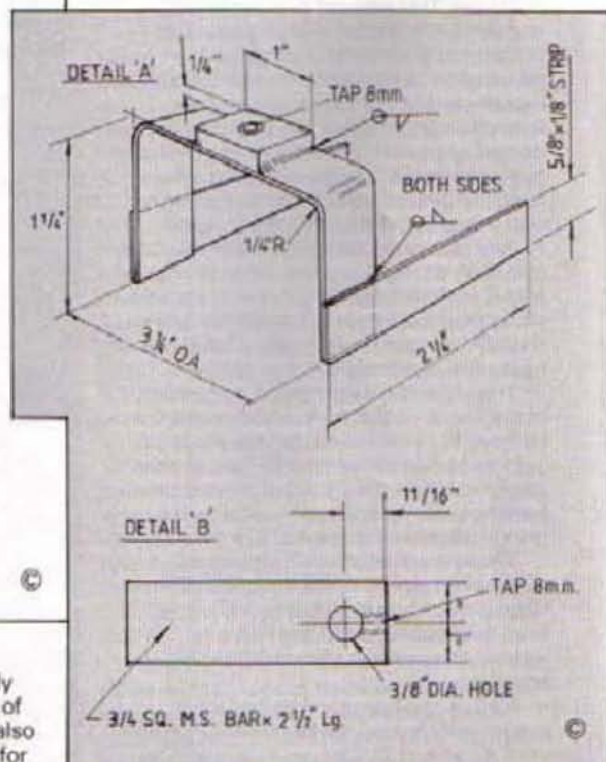
Two angle brackets are fitted at the top of the frame for the tilting block which adjusts the axis of the blade when running. This is probably the most complicated part to make, but even so it is not difficult. The two brackets are from a piece of angle iron,

2 in. $\times$ 2 in. $\times$ 1 in. $\times$ $\frac{1}{4}$ in. Before welding it in position use a spacer exactly one inch wide to get the correct gap; a block fits in here which needs to be a nice snug fit. Another piece of the angle is welded behind the frame and it has a 6mm diameter peg fitted into it to act as a support for the spring of the return mechanism.





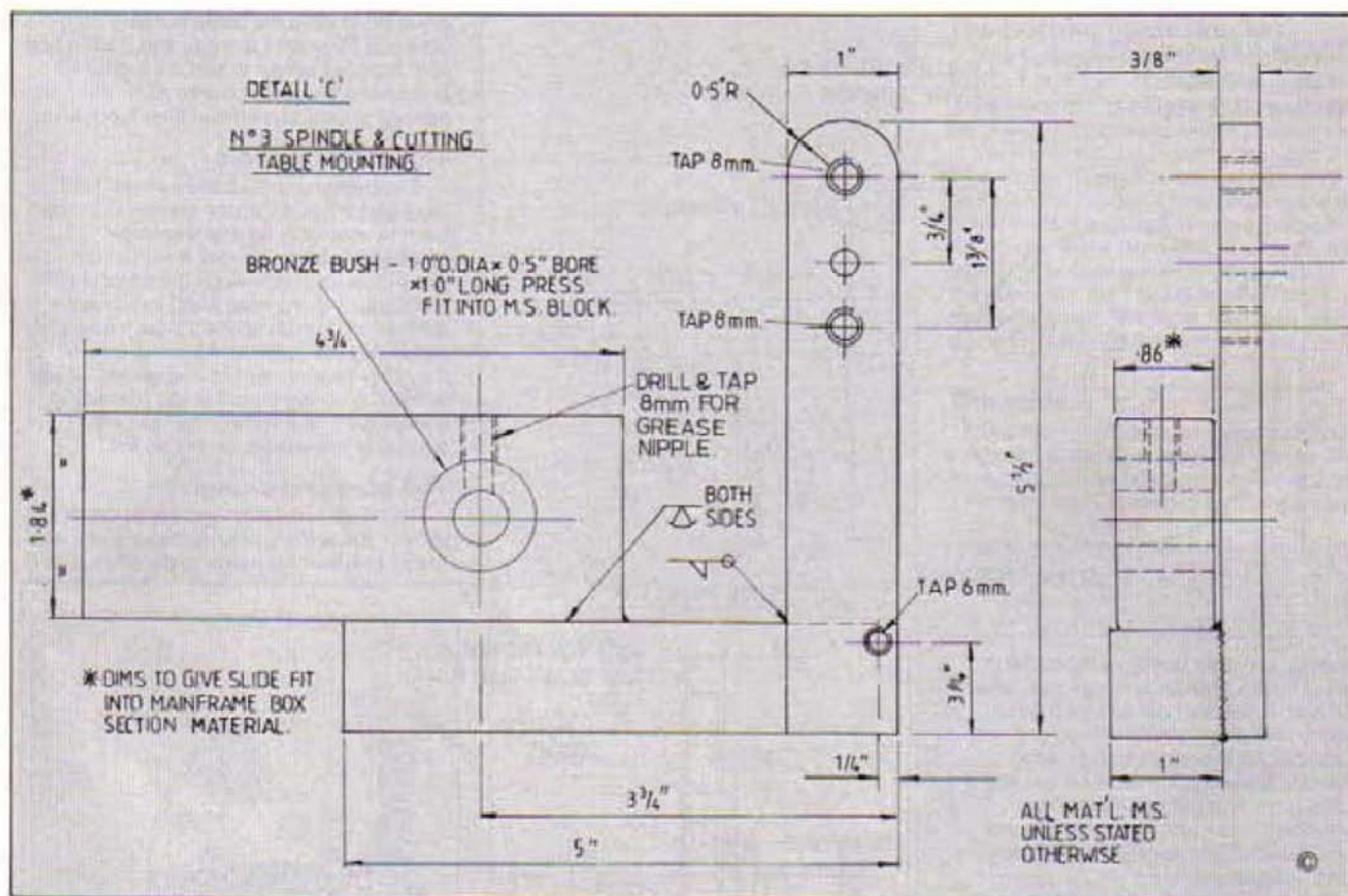
the pulley. The spindle for the pulley was made from a $\frac{1}{2}$ in. diameter Whitworth high tensile bolt but suitably hardened and tempered silver steel will do the job just as well no doubt. A grease nipple is fitted to it



On top of the two brackets is a piece of flat mild steel $\frac{1}{8}$ in. $\times \frac{1}{4}$ th in. which is bent to form an inverted 'U'. This contains a tapped boss about $\frac{1}{2}$ in. thick to hold the adjusting screw which, in my case, is 8mm diameter.

The tilting block

The tilting block itself must fit snugly between the angle brackets on the top of the frame. Apart from anything else it also acts via a suitable bush as the bearing for



in a 3mm diameter hole to take the grease through to the bearing. A thread tapped in the block and locked with a grub screw fitting crossways secured the pulley in position.

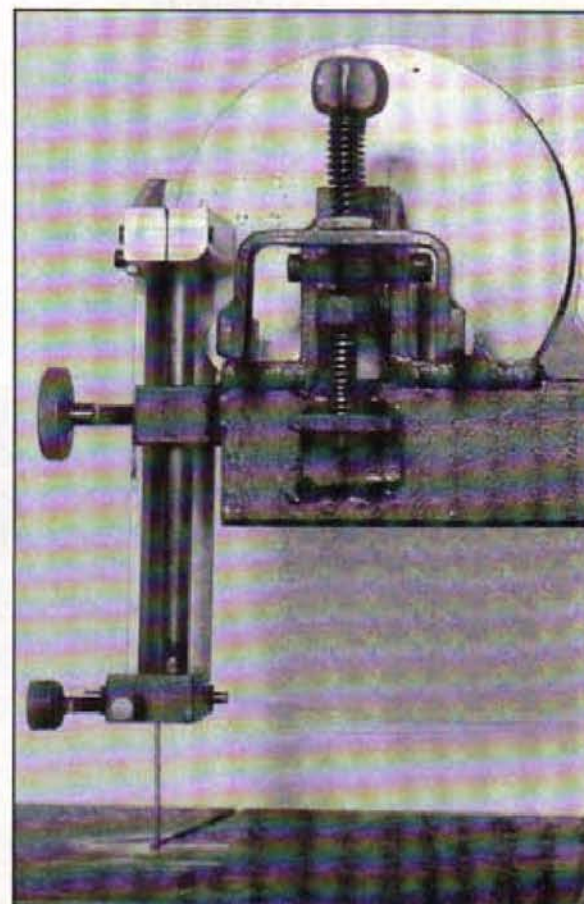
On the rear of the tilting block is a piece of 3/4 in. square steel with a 6mm pin in it which locates on the spring.

The Pulleys

If we turn to the pulleys next, then the one which, as I expected, gave most problems was the one which gives the main drive (number 3). After some hours pondering over the problem of how to get plenty of movement without the block

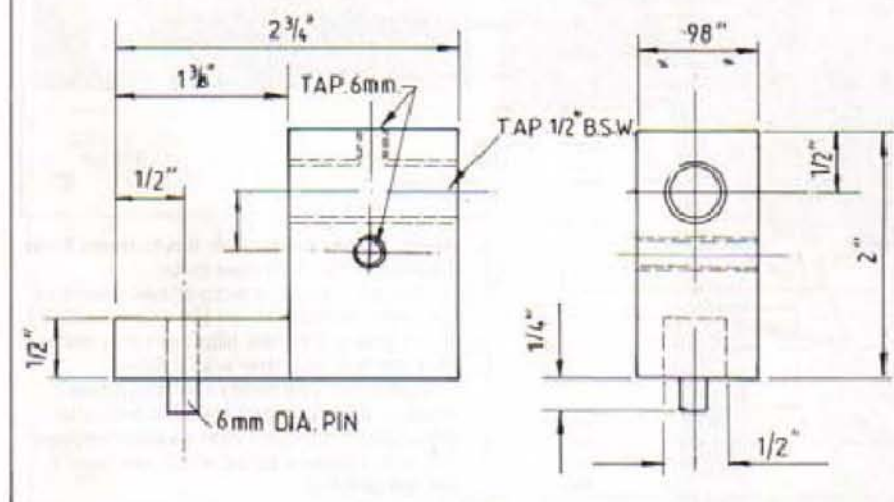


Left, a close-up of the tilting block; comparatively simple yet highly effective arrangement. Below, the tilting block from another angle, illustrating how it is connected to the frame.



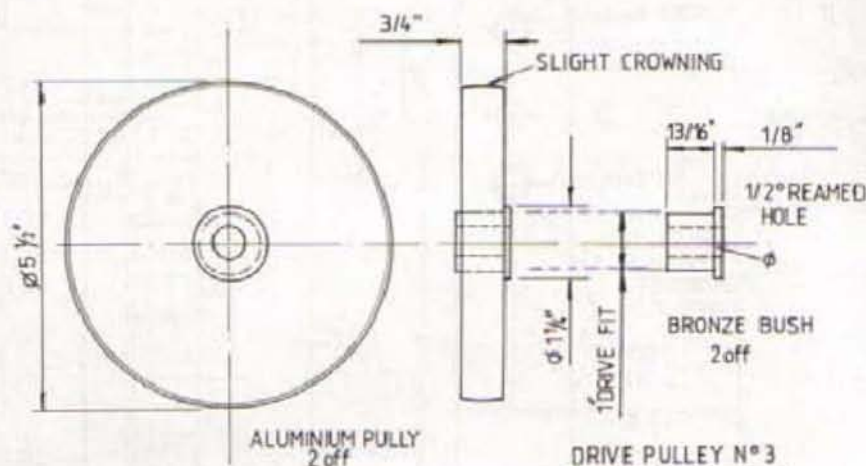
NO. 1 PULLEY AXIS TILT BLOCK.

MAT'L M.S.



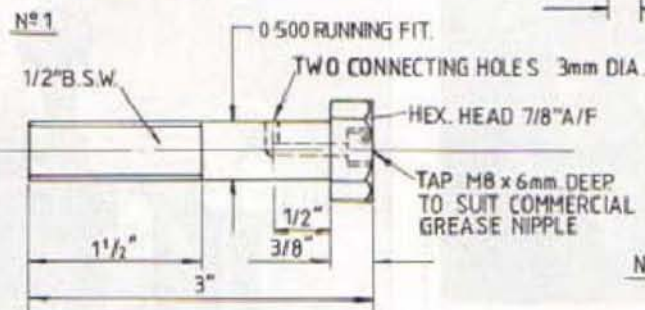
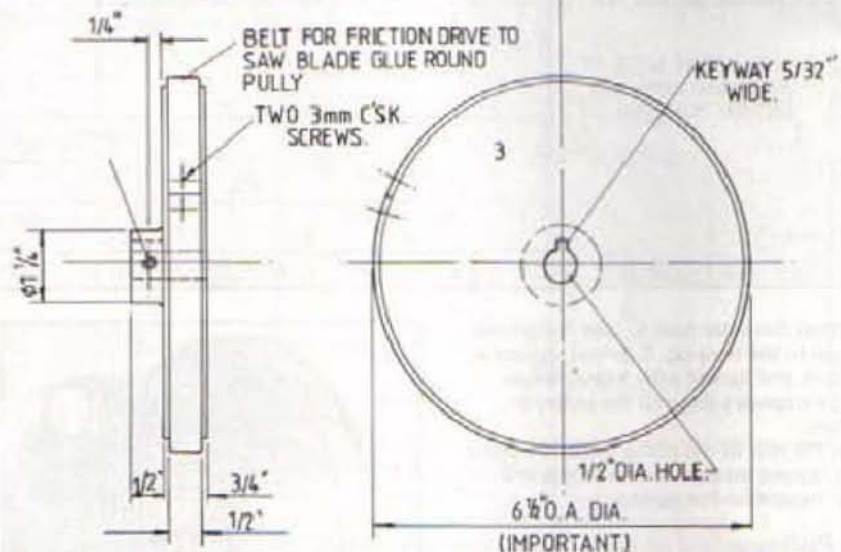
DRIVEN PULLEYS No's 1 & 2
MAT'L ALUMINIUM
DRAWN HALF FULL SIZE.

PULLEYS ARE $5\frac{1}{2}$ " O.D.
OVER CROWNING.



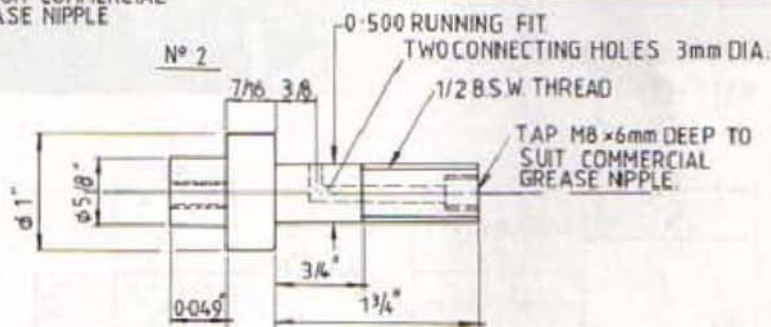
slipping, and after trying many different ideas I finalised on an ordinary vee pulley and belt. A belt was cut so that it fitted exactly round the pulley with no gap and, of course, no overlap. It was glued in position, being tapped firmly down in the pulley groove to get a snug fit. When everything was right 3mm countersunk screws were put in each end to make sure that it was secure.

The pulley is made of aluminium with an outside diameter of $5\frac{1}{2}$ in. over the belt circumference. It is $\frac{1}{2}$ in. wide. Connected to this pulley at the other end of the shaft is another of the same diameter, driven from the motor by a vee belt; this one is not home-made but is a Volkswagen fan pulley but making a suitable one should present no great problems. Actually the

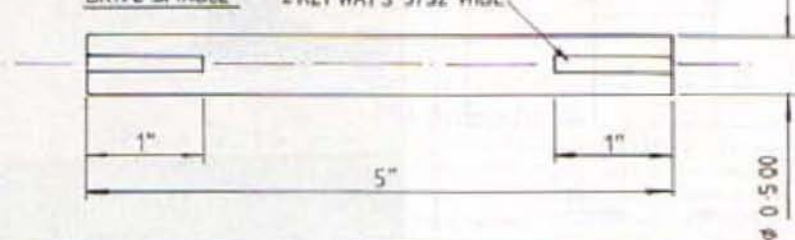


Volkswagen pulley needed some modification as the hole in the middle was much too large and had to be bushed to bring it to $\frac{1}{2}$ in. diameter which was the correct size.

The other two pulleys are straightforward enough and are made of aluminium. They are $5\frac{1}{2}$ in. diameter and are



DRIVE SPINDLE 2 KEYWAYS $5/32$ " WIDE



crowned to keep the blade running centrally. They are $\frac{1}{2}$ in. wide and are bushed with bronze bushes, which are a drive fit and have a grease groove to allow them to retain grease and maintain their lubrication.

The pulley spindle

The pulley spindle is made from mild steel and is just a fraction shorter than the bearing assembly so that the screw mentioned above will lock it in position. The pulley itself is held on the spindle with a nut which in my case was $\frac{1}{2}$ in. diameter Whitworth. A grub screw across it ensures that it stays in position. As in the case of the other bearing, a hole and grease nipple is fitted. A spring bolted to the frame and connected to the spindle ensures that tension is maintained on the pulley.

The blade tensioner

The blade tensioner was constructed as shown, following a helping hand given to a friend to adjust his motor cycle chain. The

tensioner worked for that and so why not a band saw? For ease of dismantling it was made in two pieces; the first carries an 8mm hole for the knurled bolt and is a fork-like construction which can be seen quite

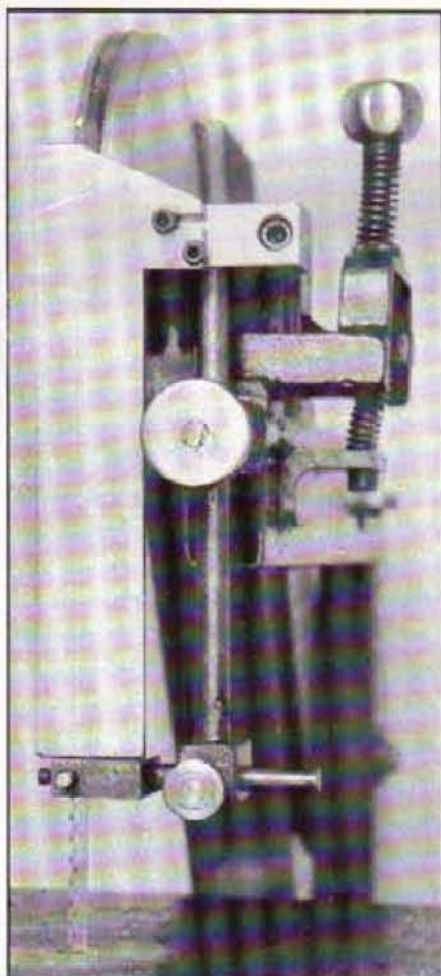
clearly in the photograph. It was made from a piece of $\frac{1}{4}$ in. mild steel plate.

The other part consists of two pieces of $\frac{1}{4}$ in. plate clamped to the $\frac{1}{2}$ in. angle welded to the frame. The fork slips over this and they are held together with a 6mm diameter pin. The pulley spindle passes through the resulting sandwich and, after adjustment, is locked with an Allen headed bolt and a large washer, which are fixed in the spindle end.

[illegible]

The bottom guide bracket was made from a 1 in. X 1 in. X 5 in. piece of angle iron and a piece of $\frac{3}{4}$ in. X 1 in. X 5 in. mild steel bar, welded together at ninety degrees and to the bottom of the insert for Number three pulley. The blade will run through the centre of the bracket. Three holes in the top of the bracket are used to retain the table, to set it to ninety degrees to the blade, and retain the bottom guide. Another hole at the bottom of the bracket is used to hold the blade guard. The latter holes are both tapped to take suitable bolts.

The table is made from a piece of $\frac{1}{4}$ in. mild steel plate, 12 $\frac{1}{2}$ in. square. It obviously must be as flat as possible; a piece of 2 in. $\times$ 2 in. $\times$ $\frac{1}{4}$ in. angle is welded to it taking care



Left, this end view shows the construction of the blade guides and their adjusting screws. Below, the belt tensioner is designed on the lines of the chain adjuster on a motorcycle; it's very robust and works well.

Diagram of the roller assembly showing the blade guide, roller, and their dimensions:

- BLADE GUIDE:** MAT³ BRASS ROD 1/8" DIA. 2off REQ'D. Dimension: 1"
- ROLLER:** MAT³ BRASS ROD 3/16" DIA. 4off REQ'D. Dimension: 3/16"
- MAT³ HARDENED STEEL:** 1/8" BORE, ϕ 1/4", 2off REQ'D.

Technical drawing of a mechanical assembly. The drawing shows a vertical rod with a hole and a horizontal plate with a hole, joined by a silver solder. Dimensions include diameters ($\phi 3/8"$, $\phi 8\text{mm}$), hole sizes ($\phi 8\text{mm}$, $\phi 6\text{mm}$), and various lengths ($1\frac{1}{4}"$, $5/8"$, $1/4"$). The material is labeled M.S.

1 off at $1\frac{1}{2}$ "
1 off at $3\frac{1}{4}$ "

SILVER SOLDER

2 HOLES TAP 3mm

$3\frac{1}{8}$ "

$1\frac{1}{2}$ "

$3\frac{1}{8}$ "

$\phi 8$ mm

$3\frac{1}{4}$ "

$1\frac{1}{2}$ "

$\phi 1/8$ HOLE EACH SIDE FOR DRIVE FIT BRASS ROLLER PIN.

$7/16$ "

$\phi 3/16$ HOLES FOR BRASS GUIDES.

Technical drawing of a Bottom Guide Holder assembly. The drawing shows a side view of the assembly with dimensions in inches and millimeters. The main body is 1 1/4 inches wide and 2 3/4 inches high. It has a 1-inch wide top section with a 6mm hole. A 5/8 inch wide section on the right has a 6mm tap. A slot 8mm wide and 1 1/4 inches long is located in the center. The material is mild steel.

BOTTOM GUIDE HOLDER

1"

HOLE 6mm

5/8"

TAP 6mm

1 1/4"

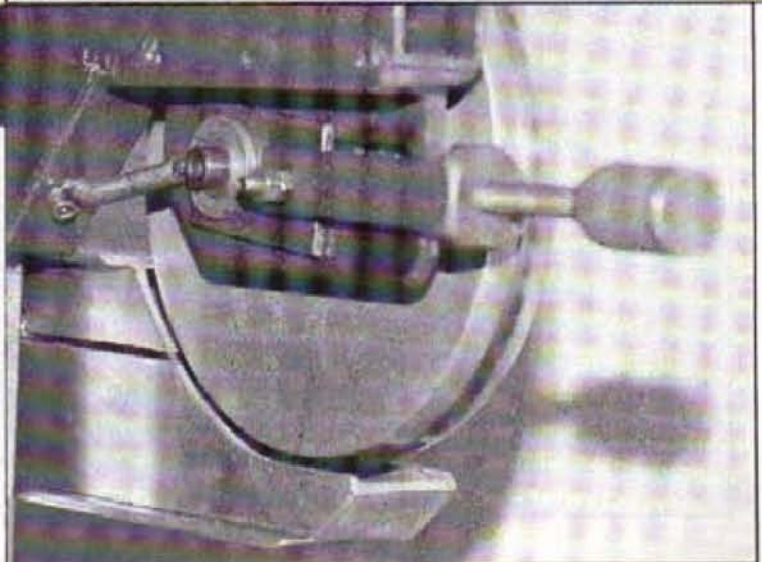
2 3/4"

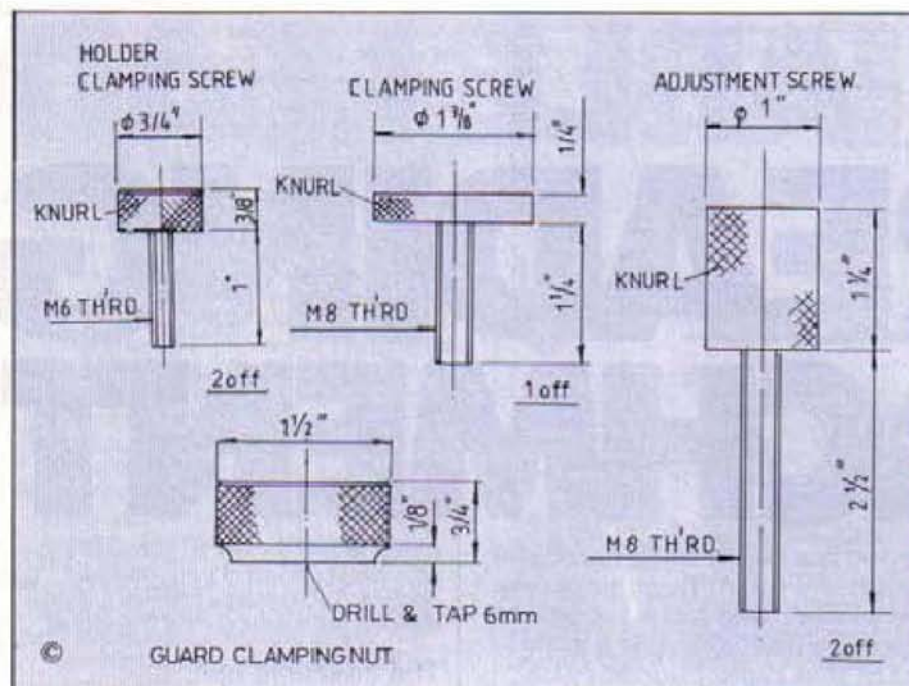
SLOT 8mm WIDE x 1 1/4" LONG

MAT: MILD STEEL

1 1/4"

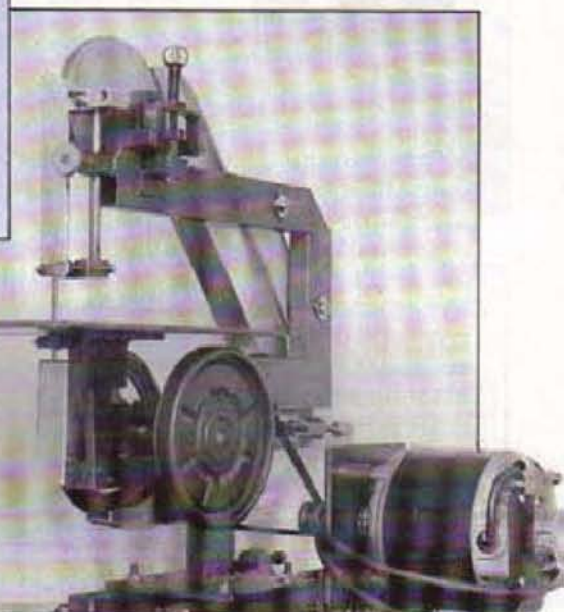
1/8"





The guards

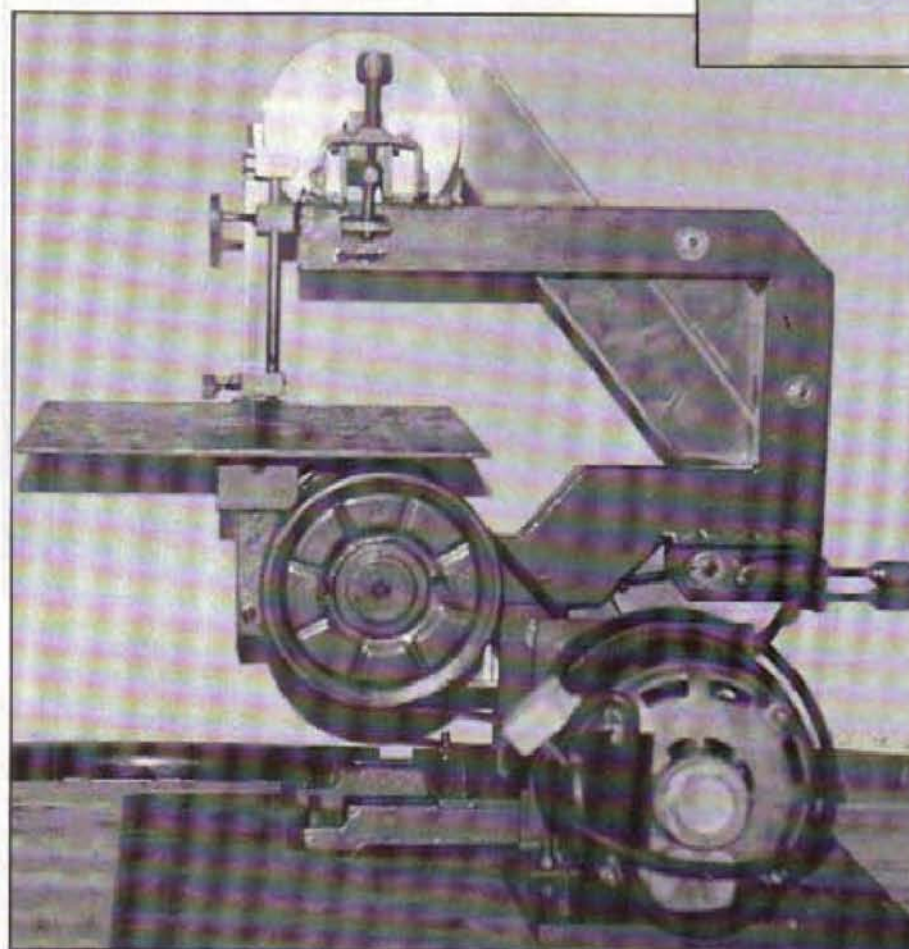
Finally, we come to the guards. These are very important as there is always an element of danger from a broken blade or flying particles when using a bandsaw. They are all constructed of aluminium box section which is easily available. They should be built round the machine taking sizes from the construction itself in order to ensure a good fit, and also to make sure that there are no gaps left which fingers can get trapped in. Guards are also fitted over the blade at the top and clamped to the adjuster spindle. Underneath the table a small guard of the channel type keeps one safe from the moving blade in that area.



The motor

The motor used was of a quarter horse-power rating. A 1 1/2 in. diameter pulley was fitted to the motor and this drove the 6 in. diameter pulley on the saw via a vee belt. The combination of pulleys and motor gives more than sufficient power for any task the saw is likely to be used for.

The views of the finished item; shot at right shows how the drive is transferred across the blade pulley.



Finishing the machine

The machine was finished by painting with Hammerite paint, which gives a good hard and attractive professional-looking finish. Whether the reader does this or not is, of course, a matter of choice. The blade is a 1/2 in. wide, 56 in. long type which is available commercially and should not be difficult to obtain. In service the saw has proved to be accurate and robust – in fact all that one could ever expect from a bandsaw.

Obtaining the materials

There should be no great difficulty in obtaining the materials with which to make the saw. The channel angle iron is available at any steel stockist, and often at places like farm suppliers as well. Even some ironmongers stock it. The aluminium for the pulleys may be a little more difficult to come by but even so should not present too many problems. Good non-ferrous metal stockists will inevitably have it in stock and will not expect it to be purchased in long lengths. It is normal for them to sell diameters such as this a few inches at a time. A small charge might be made for cutting it, but this does not always happen, and a request for an inch or so will not raise anyone's eyebrows...

The vee belt can be obtained at a garage or from a tool stockist and many other places as well. The motor can be bought second-hand or purchased new as required, and the blades are available at tool stockists.



A VARIABLE LEAD THREADING ATTACHMENT

Ted McDuffie lives in Sarasota, USA and is a highly skilled precision engineer. He is interested in horological and scientific engineering and has many attachments for various lathes that he has acquired over the years. The variable lead-threading attachment is a most ingenious device for picking up threads that cannot normally be machined with the standard equipment of the lathe. No castings are needed for its construction. Although the author has produced the device for his Myford Super Seven, it can be adapted for almost any type of lathe and, with size adjustment, could be used on the compact type of lathe. Being designed on the lines of a copying attachment, it will be particularly useful for anyone whose lathe does not have normal screw-cutting facilities.

Having altered the size, it is necessary to cut a mating thread of a non-standard diameter. This creates a problem if your lathe will not cut the correct thread lead.

The threading tool

In my machine tool and horological tool restoration work, I have encountered many unusual thread counts and thread forms and for proper restoration it is necessary to have a tool for reproducing these threads. The first such device I made was a variable threading attachment for a Southbend lathe; I have used this tool for many years and it has been completely satisfactory.

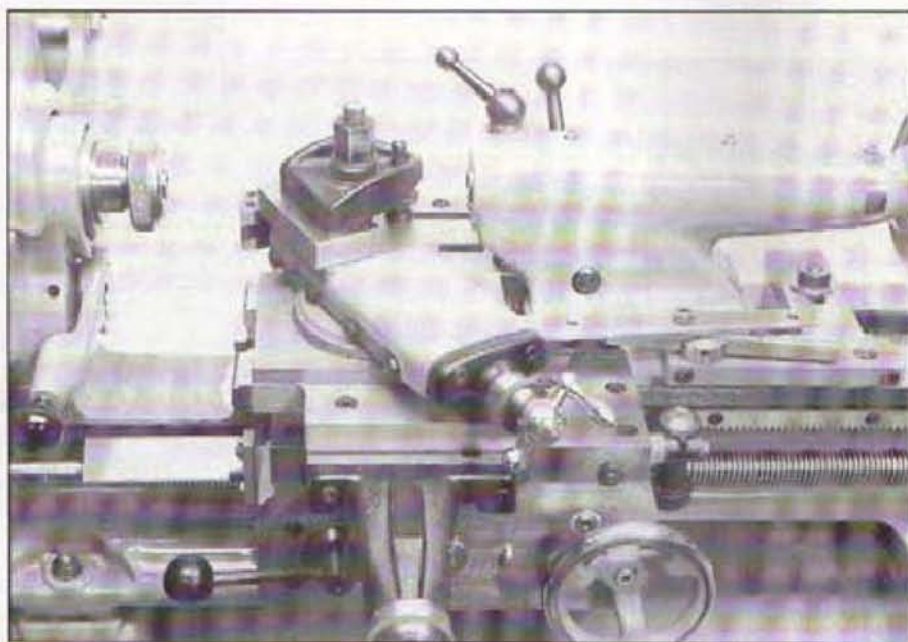
When we acquire our first lathe with thread cutting facilities we open a whole new world of possibilities for this versatile tool. We move from a basic tool to a precision tool with many new capabilities. I believe that most of us who attain this plateau in the machine tool world do so with a feeling of satisfaction that we have not felt before.

We go happily along our way with this new-found ability and find many ways to use this device that does such wonderful things. Assemblies are threaded together so expertly that one can seldom detect that they are separate pieces. This bliss rarely lasts for long. One day we find that someone else also cuts threads and their threads are different from the ones we have been cutting. When we attempt to add a part to their threaded device, we find that it is a thread count that our lathe does not recognize.

Today we are faced with a multitude of threads that are variations of thread forms in Imperial or metric dimensions. Many of our modern lathes with metric or Imperial threading gears will not cut all the threads used in the construction of the lathe and the standard tooling. For the average home workshop this does not create a problem but most lathes have inadequate thread lead choices for restoration or repair work.

We might be able to replace a special screw through a local supplier and in other situations, we can go down to the local industrial supply firm and order a tap or a die to provide the necessary thread. For a large diameter thread, for a one-off use, this can be expensive. If the diameter to be threaded is a non-standard diameter, we may still have a problem.

When repairing or restoring older equipment it is often necessary to recut a thread to correct damaged or worn threads.



Above, a Myford Super-7 with variable threading attachment. It can be used on most lathes with a centre height of 3 inches or over, with a little modification.

At left, note the mark on the upper slide with pin in the neutral position, allowing easy reference.

Recently I made a similar attachment for my Myford Super-7 3/4 in. lathe. Most home shops are not equipped for metric and Imperial threadcutting and this attachment makes it practical to cut either thread, or any other odd thread, with the same set of thread cutting gears. With modifications, this attachment can also serve as a taper-turning attachment or a contour-following attachment.

As I am able to cut these special threads, I am often called upon to repair or modify special devices that range from surgical equipment to antique automobile parts. In laboratory test equipment we find many unusual threads, and when a special extension or adapter is needed, my shop is equipped to cut the thread. Cameras have also been a source of need for special threadcutting equipment. Owners have special equipment that will not fit their new cameras, and adapters are necessary. I have also made lead screws to provide calibrated movement of special devices used in clockmaking. The list goes on and on and as long as we have at least two machinists cutting threads there will be a need for special threading equipment.

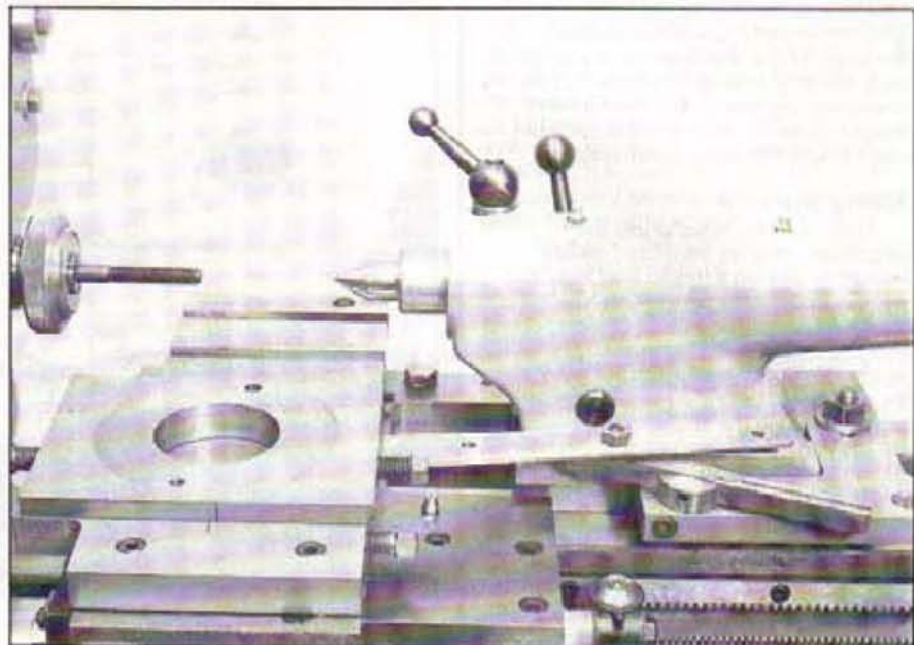
Having worked with fusee engines used in clockmaking, I am familiar with variable devices used to divide a given length into any number of segments and I used this principle in my variable threading attachment. Adapting this principle to threadcutting presented some problems but my attachment permits the cutting of any thread lead without introducing a measurable error in the thread spacing.

This attachment is designed for a Myford Super-7 but is adaptable to any lathe that has threadcutting capabilities, either metric or Imperial. The purpose of the device is to fill in the gaps in thread counts between the existing threading gear selections. As an example: if the lathe is set to cut 20 threads per inch the variable attachment permits cutting any thread count between 19 and 21 threads per inch. If the lathe is set for 22 threads per inch it permits cutting thread counts from 21 to 23 threads per inch. The entire range of the lathe is bracketed in this manner, making it possible to cut any thread lead, whole number or fraction, included within the entire lathe range.

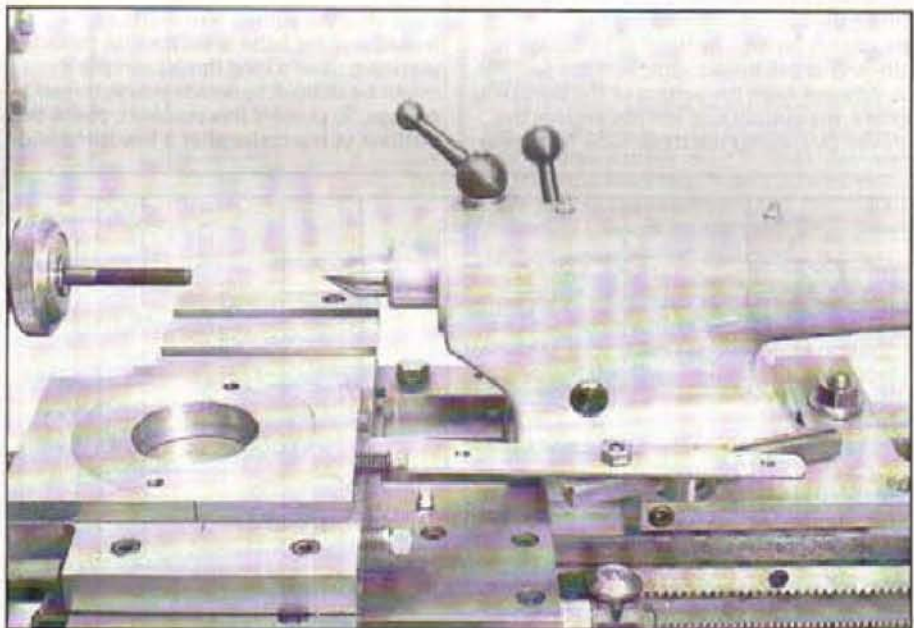
Theory of operation

The operating principle involves a variable lateral movement of the top slide which is controlled by a lever linked to the top slide. See **Photo**. Moving the lever in one direction provides a positive factor to the movement of the top slide. This is added to the carriage movement provided by the threading gears. See **Photo**. Moving the lever in the opposite direction provides a negative factor which is subtracted from the movement of the carriage. The lever that moves the top slide has a pin, the lever vane screw, that slides in a groove in a variable vane attached to the lathe bed. As the lever with the lever vane screw is attached to the top slide, it moves along the variable vane when the carriage moves. When the vane is parallel to the lathe bed there is no movement of the arm when the carriage is moved and the lathe will cut the thread count set with the lathe threading gears.

The bracket that holds the vane can be mounted in different positions and may be used on the headstock side of the tailstock or on the opposite side. The bracket is



Above, note the mark on the upper slide showing a positive factor.



Moving the lever in the opposite direction provides a negative factor which is subtracted from the carriage movement.

slotted so that the vane may be mounted in a position to contact the lever vane screw with the arm at the zero angle position. There is an indicator on the vane that indicates when the lever vane screw is in the exact centre of rotation of the vane. This position is referred to as the neutral position. For setting up a thread lead it is necessary to determine when the lever vane screw is in this neutral position.

The most critical dimension of the attachment is the length of the short arm that moves the top of the dovetail slide. The length of this arm determines how many degrees the arm must be moved to provide adequate movement of the top slide to fill the gaps between lathe gear steps. It must provide this movement without going beyond the angle that introduces an error into the movement. I have used an arm length of 1 1/4 in. centre to centre, and this has proven to be satisfactory. The movement of the slide by the arm will not be linear, as the angle of the arm is increased. In practice this error is small at the low angle

settings of the arm and may be determined by referring to a tangent table. While this error may be ignored at angles of less than six degrees on either side of centre, it is, however, important to operate the device with the arm as near parallel to the lathe bed as practical.

A typical gap in the threadcutting gear range of the Myford Super-7 is between 14 and 16 threads per inch. With 14 threads per inch the threads are 0.0714 in. apart so this requires a negative movement of 0.0714 in. of the top slide to cut a 15 threads per inch thread with the 14 threads per inch gears. This 0.0714 in. movement is provided by an angular movement of the arm of 3 degrees and 16 minutes. By centering the work so that half of this angle is on each side of the centre position of the lever, the error will be reduced to almost zero. The arm that contacts the vane is four times as long as the short arm and will require about 0.3 in. deflection per inch. I set up my work so that the centre of the thread to be cut coincides with the arm being in the

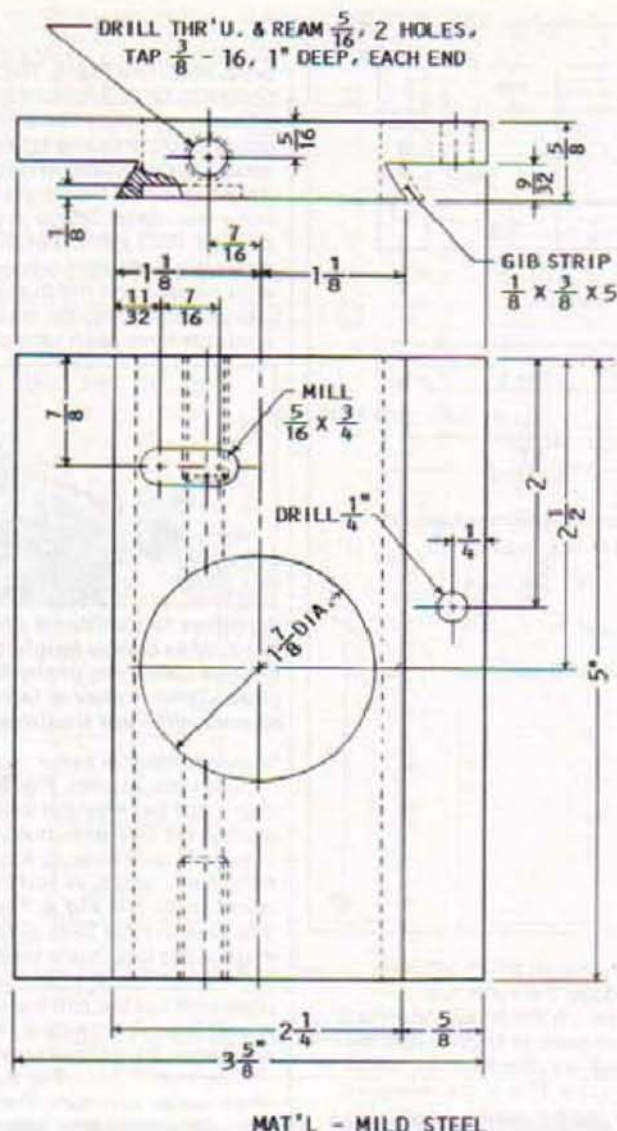


FIG. 2: UPPER DOVETAIL SLIDE

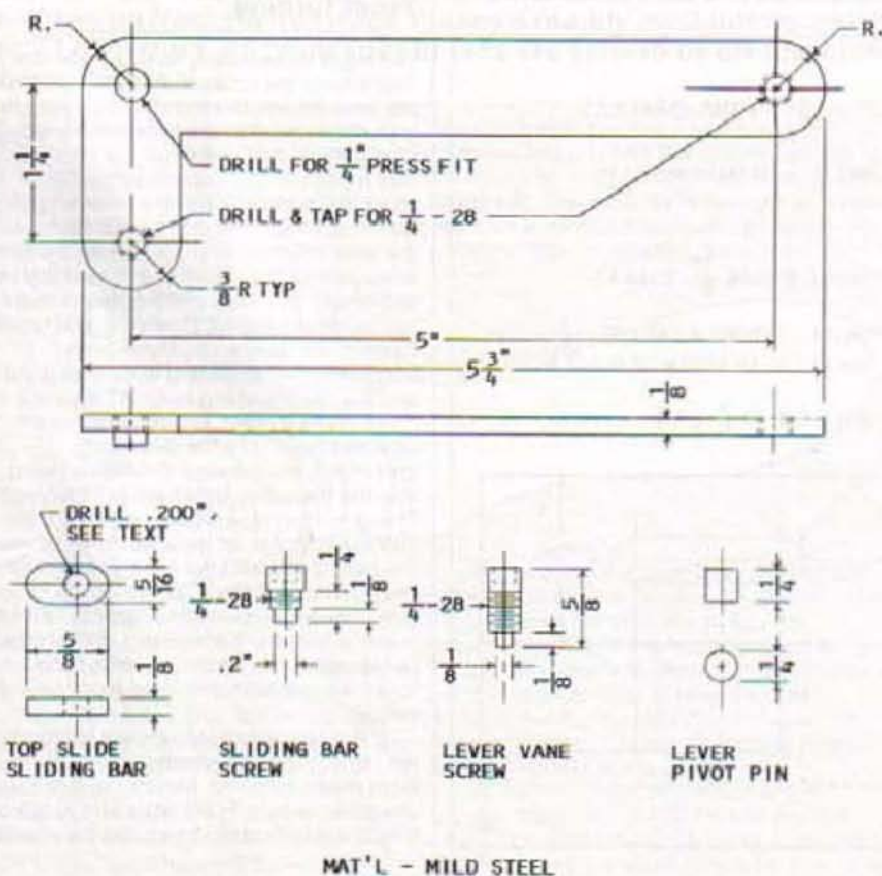


FIG. 3: LEVER ASSEMBLY

into a 'T' bar and one into a 'T' nut. See Fig. 6. Note that the socket head bolt for the 'T' nut is accessed through a hole in the upper slide. The mounting socket for the top slide on top of the attachment is a duplicate of the socket on the cross slide.

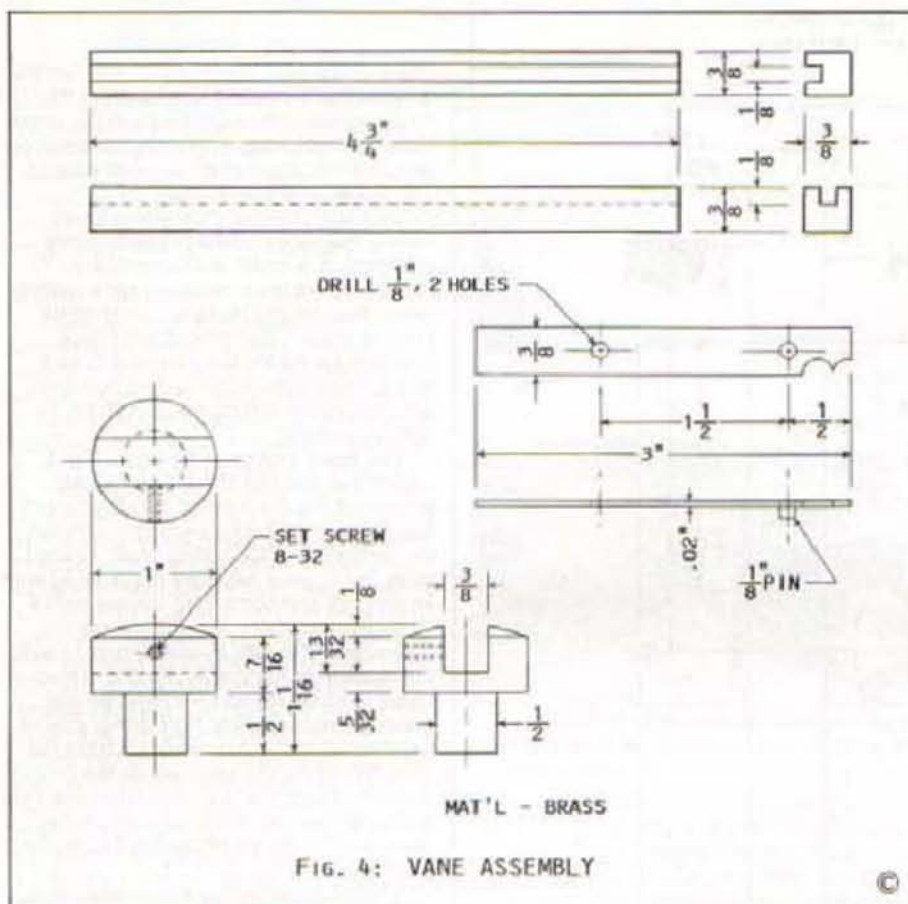
Cutting a dovetail slide with a small milling machine or lathe presents some problems. It is much more practical to 'fit' the upper and lower sections while cutting rather than relying on exact dimensions. For this reason, the dimensions I have included are meant to be used only as a guide. The following procedure has been satisfactory for cutting dovetail slides on light equipment.

The lower section of the slide, Fig. 1., was drilled and fitted to the cross slide before milling the dovetail. When properly fitted, the lower section was mounted on the vertical slide for milling. Next, I milled away the surplus metal for the dovetail with an end mill and completed the cut with a 60 degree dovetail cutter. To provide the best possible length-to-width ratio, I made the dovetail as narrow as practical. Dovetail slides must be set up for milling so that material may be milled from either side of the dovetail without removing it from the table. When the cut approaches the proper size, small cuts may be taken from alternate sides until centred. Make all cuts on the lower section before removing it from the vertical slide.

The upper section of the dovetail slide, Fig. 2., was made in the following manner: I first centred a piece of 3/4 x 4 x 5 in. mild steel on the lathe faceplate. Then I bored the 1 1/8 in. hole in the exact centre to match the mounting base of the top slide. The upper section was mounted and milled in the same manner as the lower section. As the final dimension is approached, small cuts are taken from alternate sides to ensure that the 1 1/8 in. hole is in the centre of the dovetail. If the fit turns out to be too loose, a thicker gib strip may be used but the strip should be at least 1/8 in. thick. When this is completed, the upper slide has about 1/8 in. extra width on either side. This will be milled away after fitting to the lower slide.

To get a perfect contact surface on a dovetail slide, cut with a dovetail cutter, is difficult. I have found that a sufficient contact, with free movement, may be obtained by fitting the two parts together with grinding compound. Of course, it is possible to get a near perfect contact with continued grinding but my experience indicates that this is unnecessary. When fitting the parts together with grinding compound, maintain a tight fit with the gib screws to prevent distortion of the contact surfaces.

The lever, Fig. 3, with the lever vane screw that engages the vane, is provided with a hardened pivot pin that fits into a hole in the lower section of the dovetail slide. This lever has a short arm inside the attachment at a right angle to the long arm. The sliding bar screw in the short arm is threaded into the arm and is accessible through a slot in the underside of the attachment. This makes it possible to disassemble the unit by removing this screw. The screw engages the top slide sliding bar that fits into a slot in the top section of the dovetail. The 0.200 in. hole in the sliding bar should be marked for drilling with the unit assembled. The hole should be positioned with the lever arm parallel to the lathe centre with the dovetail slide in centre position.



The vane assembly, Fig. 4, is the variable device that makes it possible to add or subtract from the lathe thread lead settings. The design makes it possible to mount it on either side of the tailstock. The 4 3/4 in. length of the vane has provided sufficient range for my applications but for special needs the length of the lever and the vane can be extended. The lever vane screw, Fig. 3, should be fitted into the vane slot without excess play, to provide a smooth sliding action. This screw is

secured with a locknut when properly adjusted to engage the vane slot.

In order to set up the attachment for a thread, it is necessary to know when the lever vane screw is in the exact centre of rotation of the vane. This is the reference point and it must be accurate, to provide a correct setting of the vane. When the vane can be rotated without moving the lever, the lever vane screw is in the exact centre of the vane base. In this position, a mark is scribed on the vane at the pointer on the

brass strip. See Fig. 4. The brass strip has proven to be satisfactory but extreme care must be exercised in marking the centre position. On previous attachments, I have used a spring loaded plunger as the lever vane screw and the centre of rotation of the vane was centre drilled to receive this plunger. With this method, it is necessary to move the lever vane screw down the vane, with pressure on the plunger, until the plunger drops into the centre hole. Both methods have been satisfactory but the



An offset toolholder is used to position the tool to centre height because of the limited clearance of the Myford top slide. Other makes of lathe will probably require different treatment.

brass indicator is easier to construct.

The vane bracket, Fig. 5, is slotted so that it can be mounted to engage the arm at different distances from the lathe centre. It mounts on a base, to space it above the lathe ways, and is locked in place with a clamp plate. See Fig. 6. The thickness of this vane bracket base positions the vane to engage the lever vane screw. A piece of 3/16 - 16 threaded stock is secured in the clamp plate with Loctite and the vane bracket is locked in position with a 3/8 in. nut and washer on top of the bracket.

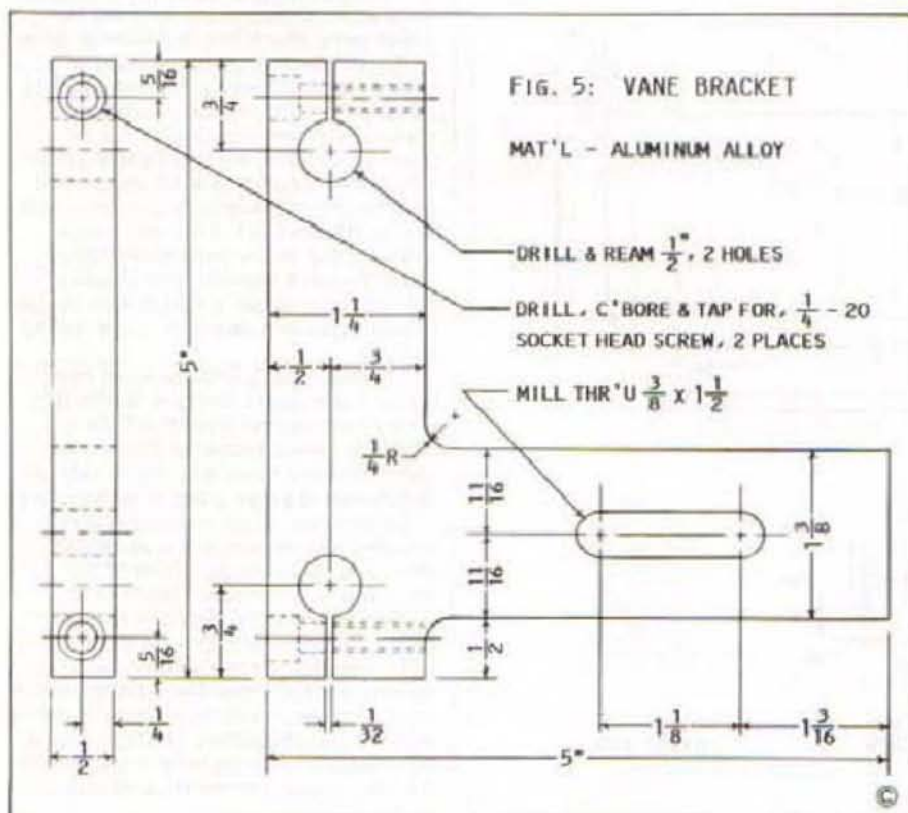
The two 'T' bars, Fig. 6, make the unit much easier to mount. They may be made of aluminium alloy or brass. In some instances, the size of the 'T' slots in the Myford cross slides and vertical slides vary, so check your lathe for proper dimensions.

Taper turning

In order to use the device for taper turning, it is necessary to rotate the unit 90 degrees on the cross slide. In this position the lever moves the top slide in a path that is perpendicular to the lathe centre rather than parallel to it. This may be accomplished by positioning the three mounting bolts in a position that engages the cross slide slots in either position. Also, the lever must be brought out on the tail stock side of the unit. If the lever is cut off to a length of 1 inch and a different lever extension is used for threading and taper turning, the device can serve both purposes. The threading lever is straight and the taper turning lever is L-shaped.

In use, the taper turning attachment operates much like the threading attachment, the primary difference being that the threading gears are not involved. The unknown taper is set up in the lathe and the cutter is set against the taper near the headstock with the lever vane screw at the neutral position. The carriage is moved down the taper as far as practical. Then the cutter is brought into contact with the taper by adjusting the vane. The lathe is now set to cut a taper with the same taper as the sample.

If it is not practical to mount the taper in the lathe, the same results are obtained from measurements. Mount the stock you are going to turn in the lathe and first make a light cut to true the stock. Scribe a mark



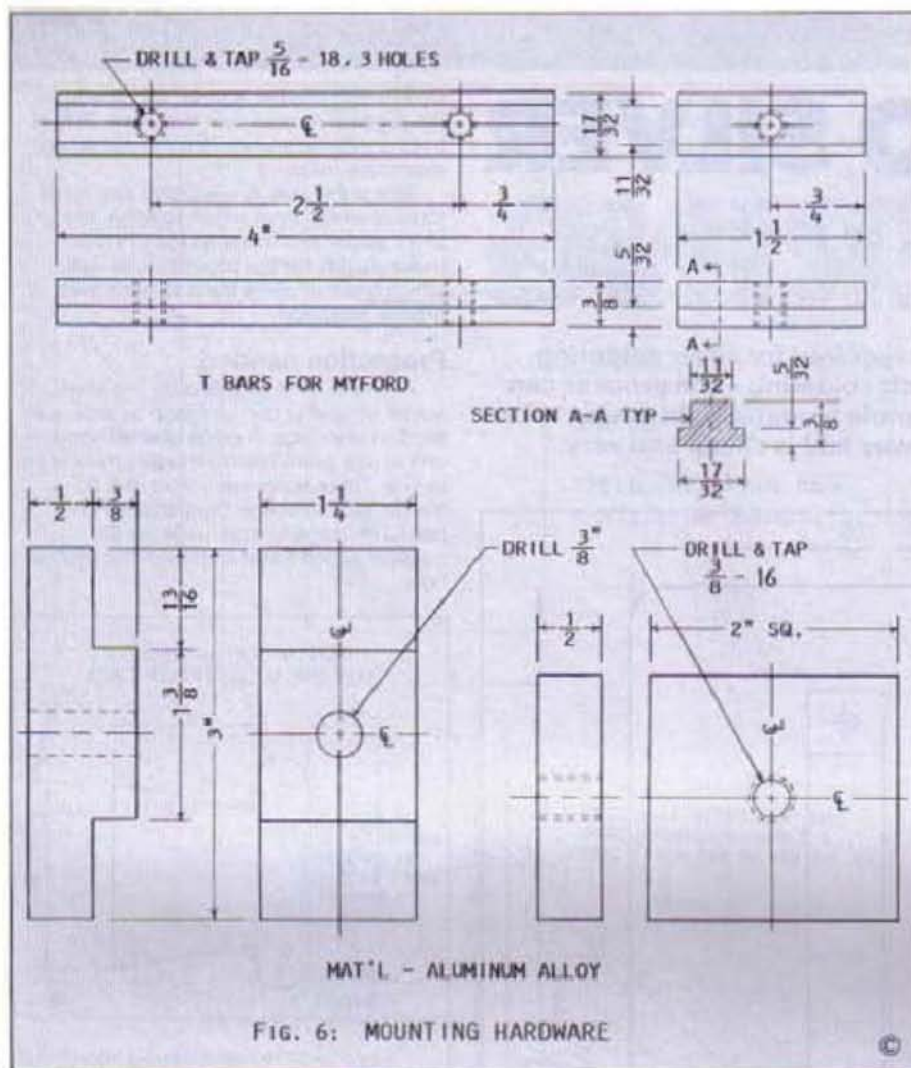


FIG. 6: MOUNTING HARDWARE

on the trued stock near the headstock with the lever vane screw at the neutral position. Measure the diameter of the taper in two positions a definite distance apart. Move the cutter along the stock and make another scribe mark on the stock the same distance from the first mark as the measurement you used on the taper. Using the cross slide dial, back the cutter away from the stock half the difference of the two diameters that you measured on the taper. Move the cutter to the stock by adjusting the vane. The lathe is now set to cut this taper.

Conclusion

With reasonable care in centring the work with the attachment, a thread of two to three inches in length can be cut with excellent accuracy. For long threads, such as long lead screws, better accuracy will be attained by cutting the screw in sections. The longitudinal rack and pinion feed will sometimes provide a carriage movement nearer the desired thread count than the threading gears and may be helpful for some threads. After using this device a few times it is a simple matter to cut a thread of any lead. As with all threading, it is important to move the carriage enough to overcome gear backlash before marking a reference point. I used mild steel for the dovetail slide because it was 'on hand'. Normalizing the steel to reduce stress, by heating to a temperature above the critical temperature and slowly cooling, will reduce warpage when milling. Cast iron is more suitable for a dovetail slide but is not readily available in my area. All parts for this attachment can be made on a Myford Super-7 or comparable lathe. Good Luck!

A SIMPLE TAPPING DEVICE

This is a simple idea from Ron Wallman who now lives in France; it is a means of keeping taps true when tapping from the tailstock. It uses a readily available accessory and involves the minimum of effort to construct. As breakages of taps are caused by off-line movement in general, it should prevent such breakages.

Here is a technique which seems to be fairly common practice in French workshops. The object is to tap holes during turnery and I have added a variation of my own.

The primary tool is a chuck handle or hand bit holder; this is a commercially available item of which I favour the Peugeot or Stanley brand. It consists of a round

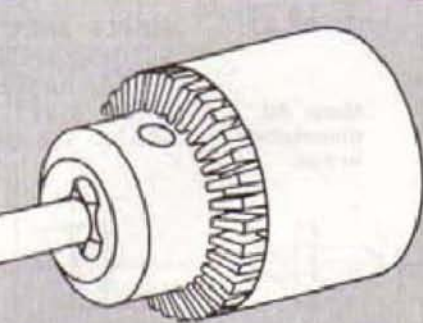
been drilled to tapping size (usually between M2 and M6) the appropriate tap is chucked into the handle which is slipped on to the rod. The tailstock is brought up to the workpiece so that the chuck handle can be conveniently run forward down the rod.

wooden handle into which a short length of threaded bar (1mm pitch) is fixed in line with the axis. A friction chuck, similar to the type commonly found on wheel braces (hand drills), is fitted to this. The whole tool is axially bored through and, in particular, the handle has an eight millimetre clearance hole.

The chuck handle is used in conjunction with an eight millimetre rod held in the lathe tailstock. Once the workpiece has

The chuck handle is used both to feed and restrain the tap into the rotating work, which allows the operator to feel the cutting action. In the event of excessive torque, the handle is allowed to slip in the hand whilst the lathe is reversed and suitable cursing is uttered! In the case of old gorilla mitts, the tap slips in the chuck. Tap breakage is a rare event.

My variant of this procedure is to transfer the rod to the drill press and the chuck handle is rotated by hand. The object is to generally tap small size holes true. The



capacity of the press is greatly reduced and the technique was used because nothing else was at hand.

The chuck handle technique has several areas of crudity. One only has to examine the alignment and fit of the wooden handle onto the rod, itself held in a chuck, to realize this. It is interesting in as much as it gives acceptable results for most purposes for a minimum outlay. It is certainly superior to the traditional tee wrench, sighting and prayer method which has no guidance other than judgement, with the strong possibility of tap breakage due to misalignment and excessive torque. The handle can be purchased at good tool stores, reference numbers Stanley 1-03-054-4 or Peugeot 81P.

AN AID TO SILVER SOLDERING

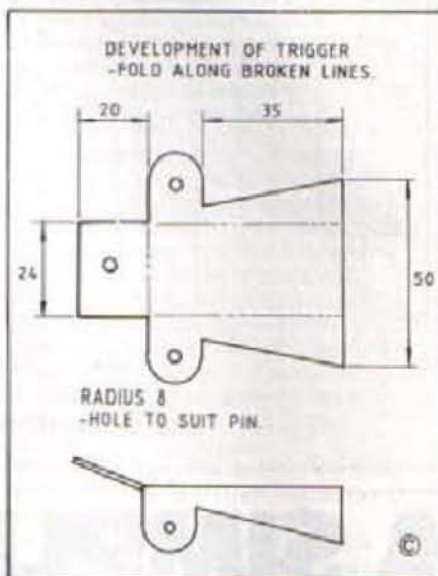
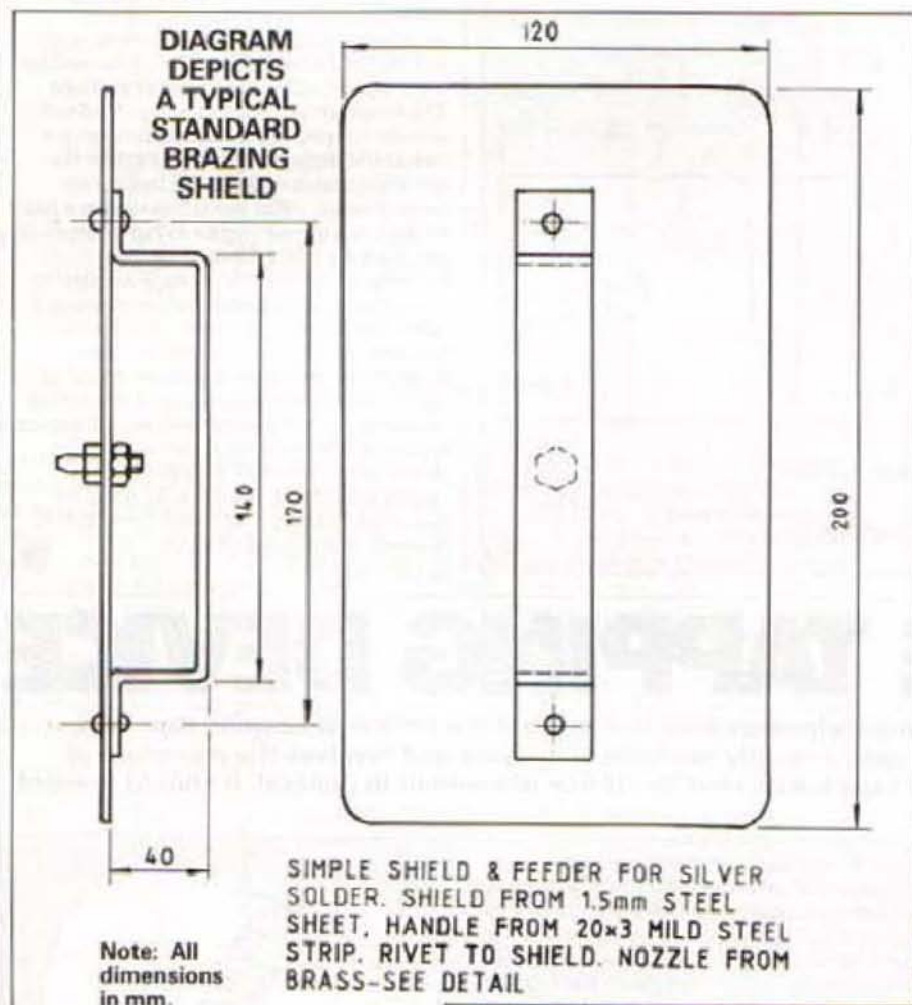
Because of the greater temperature required for silver soldering operations – as opposed to cooler soft soldering – the process can be tricky and uncomfortable. This simple feeder/shield device takes the heat out of joining metal in this way and is cheap and very quick to make.

becomes. If it is not applied accurately to the joints, it runs all over the place. This is both unsightly, and wasteful of extremely expensive material.

To combat this, it is usual to use some form of shield from which to apply the silver solder and some modellers also make shields for the blowtorch as well, which again enables them to work with greater accuracy.

Protection needed

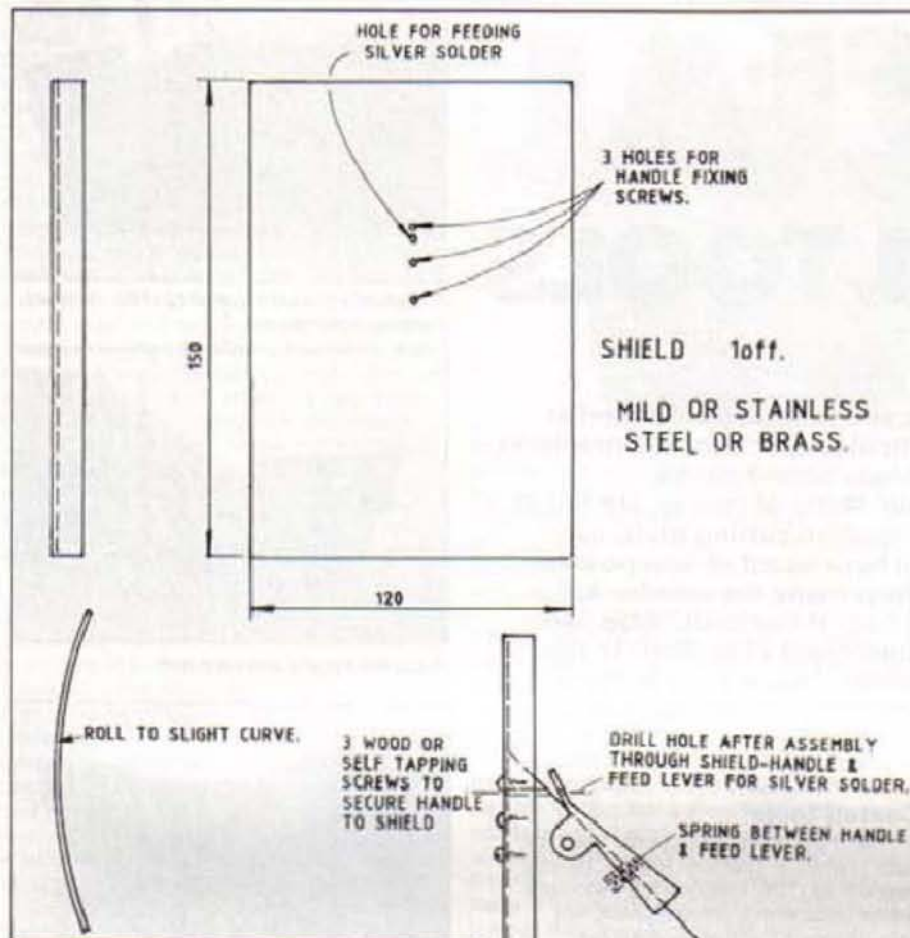
A simple form of shield for the silver solder or spelter can be made as shown in the first drawings. A piece of steel about one to one point five millimetres thick is cut to size. Three holes are drilled in it. A handle bent to shape from steel strip is bolted on and a nozzle made for the material which passes through the central hole.



The normal type of shield used for silver soldering large areas such as boilers; the solder is pushed through the nozzle and secured with the screw at the front.



The heat generated when silver soldering large work areas makes it rather uncomfortable for the operator to get near enough to apply the solder accurately. The same can be said of brazing with spelter, of course. There is no great difficulty when working on steel, but if making a copper boiler or something similar then it really does become difficult. The larger the boiler, the more heat that is needed and the harder placing the solder



The nozzle is from brass or steel and a cross-screw adjusts to the diameter of the silver solder. It is quite effective but does suffer from the fact that it is difficult to hold a blowtorch with one hand and feed the material through at the same time. In practice, there is a tendency for the solder to stick and not pass through as easily as one would wish. This often leads to a greater length being extended through the nozzle to the area of heat, and again there is a lack of accuracy and a waste of material.

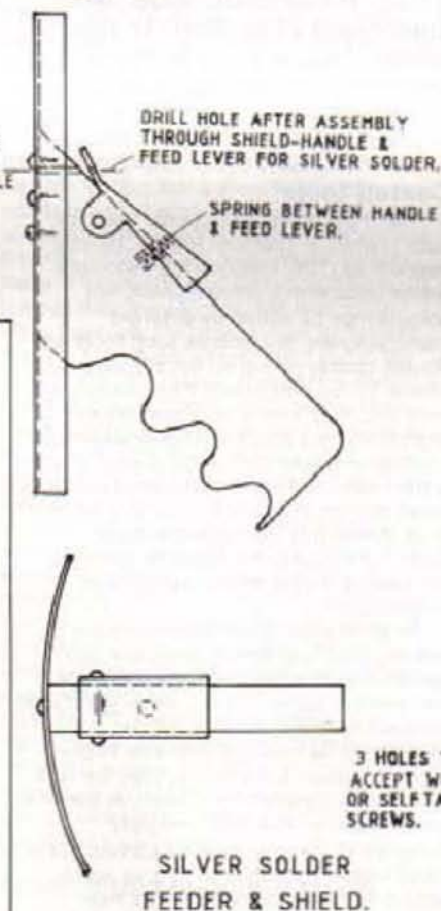
Something of a 'Rolls Royce' type of shield was thought up by Allan Turner. It will be seen that the shield is made in this case from stainless steel which is more resistant to heat than mild steel. However, if stainless cannot be obtained, mild steel will do quite well.

The handle is made from thick plastic sheet, but care must be taken not to use a plastic that becomes soft at too low a temperature, and a very good alternative is a piece of hardwood. It is fitted to the shield with self-tapping screws.

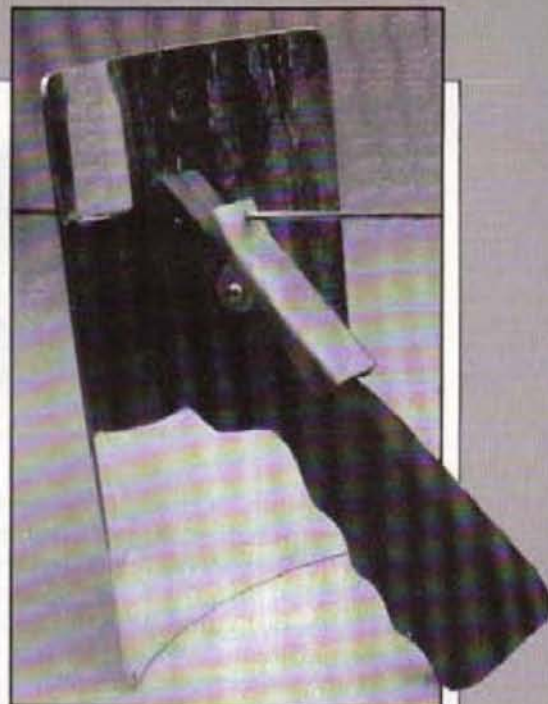
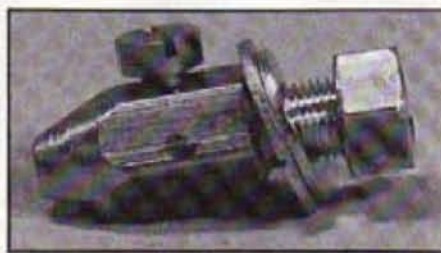
The feeding clip is folded up from mild steel sheet and secured to the handle with pins. The hole for the silver solder should be drilled in this while it is in the flat condition.

When the whole device is assembled, pass a drill through the hole in the feeder and continue through the handle and shield. This ensures that they are all in line. Make sure that the feeder is a nice easy moving fit in the handle.

In practice, the solder can be placed in the device and fed through a little at a time by simply releasing the clip and holding the device downwards, leaving the other hand free to keep playing the torch on the work.



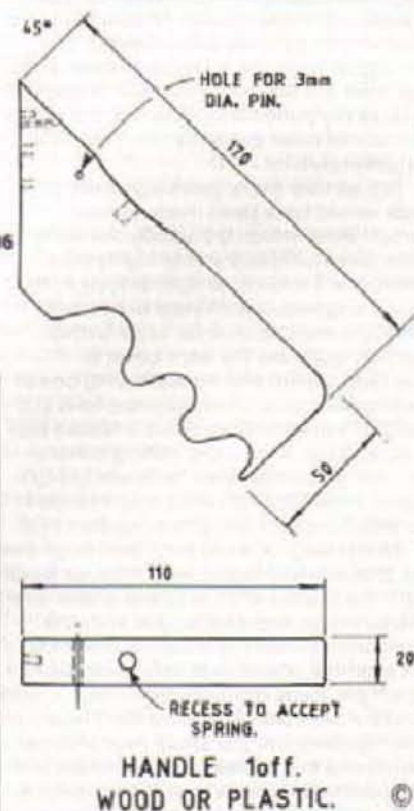
An enlarged view of the nozzle in the basic feeder idea; although a useful aid, the system has problems when it comes to feeding the solder which our improved design described here overcomes.



The improved silver solder feeder and holder as designed by Allan Turner and seen here (above) from the rear. Note extremely simple construction.



The lever feed mechanism seen in close-up; the lever is simply folded from mild steel and, when pushed down and the holder angled downwards, the solder feeds itself through.



SPECIAL MATERIAL TOOLS

Although many of the new materials and methods are aimed at modern high tech industry with its rapid output and high precision, there is no reason why some of the ideas should not be incorporated into the home workshop. Many, of course, are not at all suitable but some, like the use of modern cutting tools, can increase efficiency. Most readers will have heard of (and possibly used) tungsten carbide tooling, but how many, we wonder, know what they have to do to get the best from these tools? Also, what, if any, are the advantages of the various types of tooling? In this article we offer help and advice in a limited basic form to those who have neither knowledge or great experience of these tools.

On the whole, modern tools of special materials are designed for use in industry, where rapid production methods are in use. However, these tools can be very useful in the model engineer's workshop. In order to get the best from them it is essential to know something about them. As a rule, they all seem to be lumped together under the name of 'tungsten carbide' and, the name apart, little is known of their uses.

There are, in fact, many materials which are now in use. Some are used to make complete tools, others are just the cutting tips joined to other materials and some are only hard coatings on standard materials (usually high speed steel). Of course, apart from efficiency, price is invariably a consideration in the home workshop, and this rules out some of the harder materials such as diamonds and ceramics, the type of material most generally available being tungsten carbide.

Not so very many years ago most lathe tools would have been made of high-carbon steel, which is basically the same as silver steel without the nice high polish. There is still a need for special tools in the model engineer's workshop to be made from this material in order to save cost. Virtually gone are the days when to purchase a lathe tool meant buying one of carbon steel, and while the material is still used for taps and dies where a limited life is acceptable, lathe tools, milling cutters, etc., will almost certainly be made of high-speed steel, although drills only intended for woodwork are likely to be carbon steel.

At this stage it is not proposed to go into the properties of high-speed steel, as it will form the subject of an article at a later date; it is, however, intended to deal with the more common forms of harder materials. For example, some tools can be obtained which are made from carbon or high-speed steel but are coated for extra life. These coatings keep the tool sharp over a longer period and this has advantages where tool sharpening is a problem as it frequently is in the model engineer's workshop.

Coated tools

The most common material used for such coating is Titanium Nitride, usually denoted as (TiN). Plain nitride treatment leaves tools with a greyish finish, but colours may be added by different manufacturers. Sometimes such tools are double-coated giving an extra thickness of nitride. When purchased, these tools are excellent, they have a very long life but sharpening is a specialised operation and coatings will eventually wear away. In fact, some coated tools are designated as throw-away, and are not meant to be sharpened at all. Whilst this may sound a rather extreme measure, the extra life given by the coating makes them a reasonable proposition.

All tools when ground are naturally reduced in size. A throw-away tool will remain true to size to within a couple of microns throughout its life. Many good tool stockists will have them and if no sharpening facilities are available in the model engineer's workshop, they are well worthwhile considering. It must be borne in mind, however, that they are really designed to allow work to be carried out at much higher speeds than normal and to reduce friction and therefore the heat produced. A side effect of this is the fact that, as the speeds of operation likely to be used in the home workshop nowhere near reach the maximum permissible, there is less need for coolants and the mess we associate with them. On the debit side is the fact that, unless there is some increase



A typical carbide-tipped tool for normal turning operations.



A useful tipped parting tool.



A tool designed for screw cutting purposes with a brazed-on carbide tip; all the three tools shown above are part of a set from Sert Precision Tools.

in speed and feed when machining, they are not being used to their best efficiency, and some of the advantages of the coating will be lost.

Tungsten Carbide

Tungsten Carbide is the most common material we will come across in the search for harder tooling, and it can be used in a whole variety of forms in the model engineer's workshop. Most readers will have seen or used some of the tipped tools that can now be purchased at reasonable prices. Their advantages include the fact that they retain their cutting edge considerably longer than high-speed steel as long as they are treated somewhere near properly. The material has been in use for many years now and is commonly seen on masonry drills where a small carbide tip is brazed to the end of a normal carbon-steel tool shank.



A small tool by Stellram with a replaceable tip; the tip is held in place by the screw in the centre.

The material, like titanium, is meant to be used at higher speeds than normal carbon and high-speed steel, and so rotational speeds should be increased. It is not possible to emulate industry but a fifty percent increase in cutting speeds at least is recommended. Of course, when large odd-sized castings are mounted on a lathe this speed increase cannot be achieved except at the expense of shaking the lathe and workshop to pieces. The tools will still work well at lower speeds and cut hard materials which we normally might not contemplate and so are still worth using in those circumstances. Again, the long life of tungsten means that they do not have to be sharpened during the course of operations, providing a tool in reasonable condition is used in the first place. As with coated tools, because less heat is generated when carbide tooling is in use, there is less need for coolants.

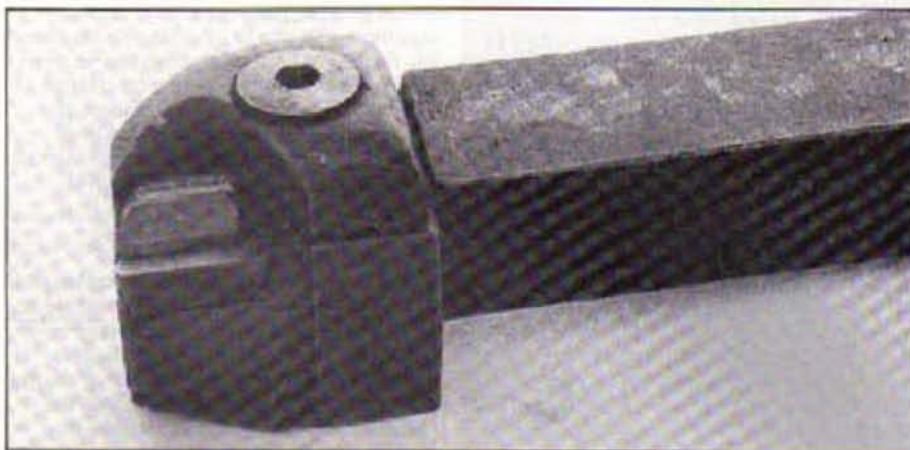
Tool setting

One thing that is essential with tungsten carbide tooling is that the tool must be set at the exact centre height. Of course, all tools should be set in this way but with carbide tooling, failure to do so rubs the tool away, and there is absolutely no advantage whatever in its use. It is also essential that the tool is set so that the correct angle is used. It is no use setting a tool in the tool post at such an angle that the rake provided by the manufacturers for maximum efficiency is destroyed and the cutting edge is rubbing rather than cutting.

Carbide tooling can be obtained with the tools made entirely of the material or in the form of inserts, either loose or brazed to the parent stock. Solid carbide tools are more likely to be found in the form of drills, end mills, slot drills, etc., and are very good. They enable very hard materials to be machined. Recently a ball-bearing was drilled with a $\frac{1}{16}$ inch drill of solid tungsten carbide, without making any attempt to soften the ball first. There was absolutely no problem in so doing. In the case of drills and end mills it is essential to avoid sideways movement of the tool. They will take all the downward pressure that can be applied but are inclined to break if a sharp sideways thrust is induced.

Replaceable tips

Turning and boring tools, as well as some milling cutters, can be obtained with replaceable inserts of tungsten carbide. The advantages here are obvious: when the tool wears, you simply replace the tip. Some tips are indexable and can be used on three or four cutting faces. These tools can be obtained in quite small sizes. With the manufacturer grinding the cutting angles there is never any need to worry about whether these are right or not. Various types of tip can be bought to fit such



tooling, each being designed for a different purpose. For most of our needs, however, plain tips will work quite well, with an alternative to use a tip with a slight groove in it which is designed to break up the swarf as it leaves the work. Tips are inclined to shatter on work where interrupted cuts are taken – for example, when turning square or rectangular bar to a diameter. They are not therefore recommended when this sort of work is to be carried out.

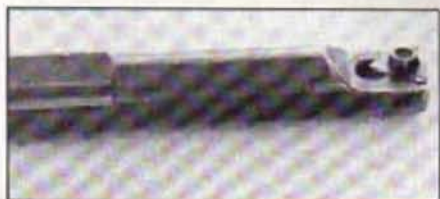
Tools with brazed-on tips are some of the most common forms of tungsten carbide tooling and are easily available. A whole range of such tooling can be bought at reasonable prices. Sometimes modellers find the results of the tools disappointing; there is no reason why this should be so as long as they are correctly set and, more often than not, the problem lies in the fact that the tools have simply been put in the lathe and it has been assumed that they have a magic property which will make them work no matter how they have been set. They do not have such properties and it is important that care is taken to make sure that they are set correctly.

Tungsten carbide can be obtained in short lengths for making one's own tools, ideal when making boring bars, etc. The material can be cut to length by grinding half-way or more across the width, then striking with a hammer whilst held in the vice and wrapped with rag. Always wear eye protectors for this and similar operations. It can be either brazed to a parent stock or fitted to mild-steel bar and held with screws and a clamp. The advantage of this is that tools can be ground to special shapes and it's particularly useful for form tool making.

Brazing tips to parent stock

Brazing or silver soldering tips to a parent stock is not difficult. For best results a copper shim should be fitted between the stock and the tip. If silver solder shim material can be used as the brazing

A much heavier tool with replaceable tip; in this case the tip is held by a clamp, a better arrangement but one which can only be applied to heavier tools.



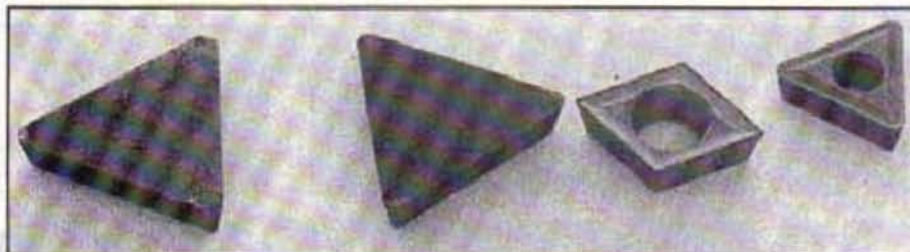
A boring bar with replaceable tip; being very small it is particularly useful for accurate hole boring.

medium, being inserted either side of the copper after thoroughly fluxing, and the whole thing heated until the silver solder melts, the tip should be well fixed.

After brazing, the tip should be sharpened. Green grit grinding wheels are essential for sharpening tungsten carbide, and small diamond laps are used for honing. Diamond laps may sound expensive but in fact can be bought at quite reasonable prices. Tips for self-brazing can be purchased at most tool suppliers in a variety of shapes and sizes. A useful idea is to try and get hold of some of the tiny tips used on circular saws. Silver solder these to the parent stock and then grind to shape. Because these are very small, they are particularly useful for making very tiny boring bars and turning tools and are ideal for modelmaking purposes.

Purchasing them from a tool supplier usually means buying a quantity of fifty or so, and it is unlikely that this number will be needed. Firms specialising in saw sharpening for industry will usually be able to supply one or two and they are very cheap. It must again be emphasised that they must be ground to shape and honed after fixing to the tool stock. Again, always use eye protectors.

Whilst the use of hard tooling as just described has advantages, there will probably be, for many years to come, the need to use high-speed steel in the model engineer's workshop for ease of working and reasons of cost. Hard tooling has many advantages when machining hard materials and should find its place at least for purposes such as these. Remember, though, if not used with care it will chip quickly. Used properly the results can be quite amazing with superb finishes and quick metal removal. It can be used with success on all the harder materials and even chilled castings can be machined.



A selection of replaceable tips. The grooves are to allow for swarf clearance and they are known as 'chip breaking' tools. The plain ones can be brazed to parent stock to make either turning tools or fly-cutters.

Although this magazine is intended primarily as a medium for matters of mechanical construction, etc., in this day and age it is impossible to ignore electricity and electronics. It is within living memory that many model engineers worked with treadle lathes and hand-wound bench drills, whilst turning out work every bit as good as some we see today. We would, however, be looking backwards if we did not recognise the existence of electricity and electronics, and, whilst we do not intend to become an electronics magazine, it is only right and proper that the subject be dealt with adequately.

It is realised, of course, that very many model engineers are only concerned with the mechanical side of things and electronics is a foreign field shrouded in mystery. Perhaps we can create sufficient interest amongst such readers to enable them to get even more from the hobby. These days many of us have home computers or there is at least one in the family. With only a little knowledge, these can be put to use in the hobby and so create another dimension to workshop activities.

New methods

It is all too easy to believe that we are too old for new methods — you can't teach an old dog new tricks, etc. This is not entirely true, however. With the final disintegration of a much-loved portable typewriter the editor decided to invest in a cheap computer with word-processing software. First attempts to use it were quite laughable. The reason for this (as it was found out later) was that the handbooks are written in computer language. What the buffs have done is take ordinary English and use the terms with a slightly different meaning (a connecting lead, for example, is called an 'interface', but is only a couple of plugs on each end of a piece of wire!) Colons, full stops and commas are no longer just punctuation marks but also give instructions to the computer. Frequently the manuals do not make this clear as they tend to assume that those reading them know what the expressions mean!

Basic electricity

After all that, let's start with basic electricity. Of course everyone is familiar with it, we are always switching this and that on and off, but do we really understand what is happening when we do so? The best thing to do then is to start by explaining what electricity is. Without this basic knowledge it will be very difficult to construct some of the devices which we have in store for you...

Electricity is all around us but in normal

circumstances goes unnoticed until our attention is drawn to its existence by events like flashes of lightning or the sparks from static electricity when we comb our hair in semi-darkness. Surely most readers are familiar with the simple experiment of causing a comb to attract paper, etc., and it is not intended to wade through all of these!

Understanding the basics

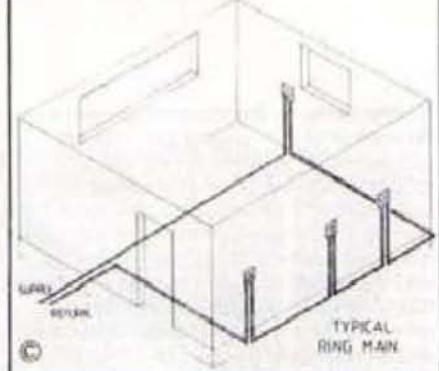
We need to go back to the atom to get our basic understanding. If we examine an atom we note that it is comprised of particles called electrons, protons, and neutrons. Electrons have a negative charge, protons a positive, and neutrons, as the name implies, are neutral and have no electrical charge. If electrons are excited by some means they move at a speed close to that of light. Excitement can be caused in a variety of ways, such as a battery or generator, etc.

Direct current

If the exciter is a battery the result is direct current, or dc, which means that it flows in one direction. In practical use, however, a second wire is used to allow it to return and in the meantime to have carried out any work we require of it that it is capable of doing. A typical example being the case of a torch. The current leaves the negative battery terminal, flows through the bulb and returns to the positive side of the battery. Only when this circuit is complete will the bulb light up. The on/off switch simply breaks the flow of electricity or connects as required. These days direct current is only usually used at low voltages.

Alternating current

If the exciter is a generator then the current will be alternating which means that it flows alternately in one direction and the other. The current is called alternating



or ac. It is this type of current that is supplied through the mains. Normal mains supply in Great Britain is two hundred and forty volts.

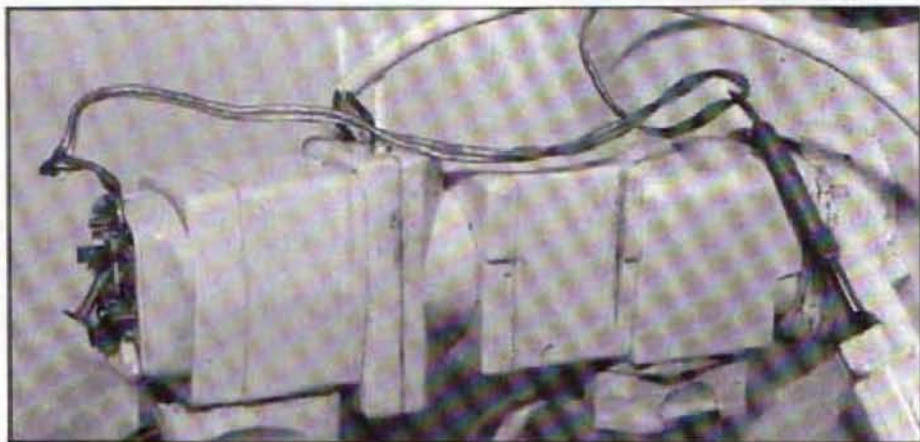
Voltages

Most proprietary electrical equipment we buy will conform to this voltage, but care must be taken when purchasing foreign equipment to ensure that it is designed to work at U.K. voltages. Some equipment meant for work on building sites, etc., in Great Britain operates on one hundred and ten volts, that being the voltage normally supplied by portable generators. Obviously, such equipment cannot be used on normal mains without a transformer.

Three-phase electricity

Some equipment we buy might use three phase electricity. Normal domestic supplies have three wires, live (usually associated with the colour brown) neutral (usually associated with the colour blue) and earth usually the colours yellow and green. Three phase current could very

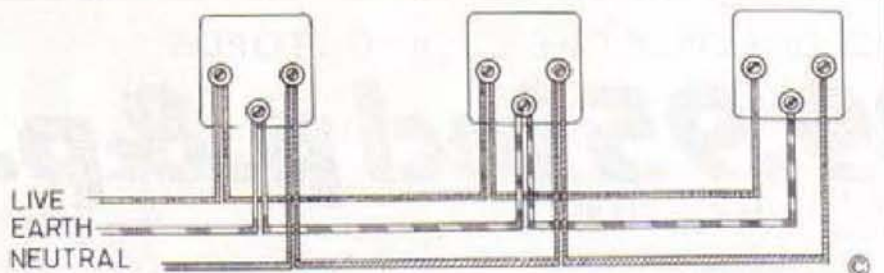
Definitely not the way to do it! Although a posed shot to demonstrate some of the possible liberties taken with electricity, it's alarming how often one or more of these faults is seen. What's the situation in your workshop?



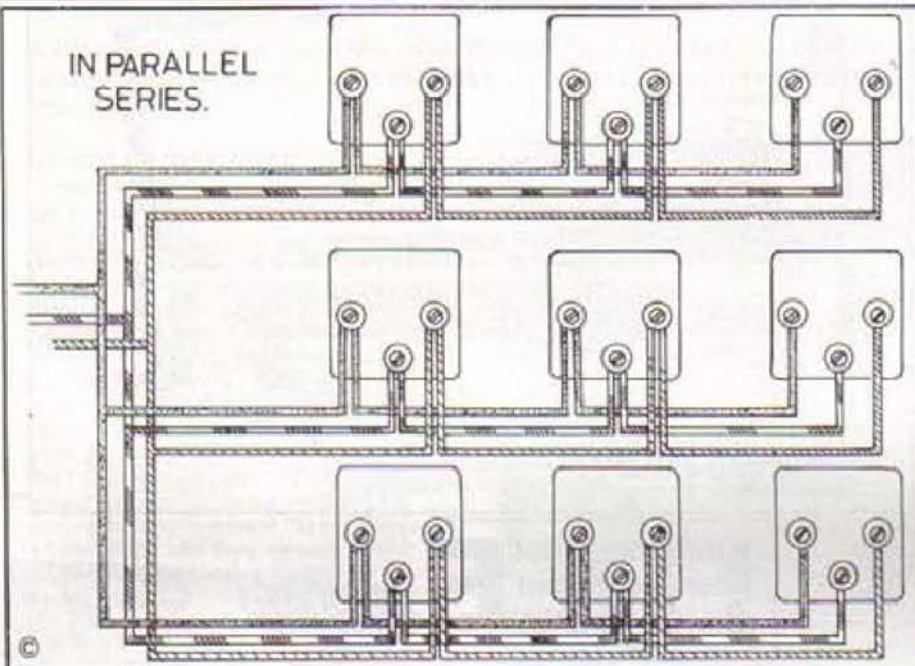
Taken for granted and frequently misused, electricity in the home-workshop can be either a reliable friend or deadly enemy. Here the basics are discussed for those setting-up a new workshop or contemplating a spot of rewiring.

ELECTRICITY IN THE WORKSHOP

IN SERIES



IN PARALLEL SERIES



loosely be described as having two live wires instead of the usual single one. This allows easier starting of large electric motors, etc. It is quite possible to use three phase motors in the home workshop providing a converter is obtained which will convert the current from normal single-phase to three-phase. It is also possible to convert such motors to run on single-phase current but it is not intended to proceed further along that road at this stage. It is worth remembering though when starting a workshop or considering the purchase of machinery, particularly second-hand, that three-phase machinery will often be considerably cheaper to buy than that designed for single-phase work....

Connections

Care must be taken when wiring equipment to connect the wires in the correct order — under no circumstances

must live be connected the neutral, etc. Care should also be taken to ensure that bare live wires are not left around, and that any trailing wires are secured at frequent intervals to a permanent surface such as a wall. If they are left running on the floor then it will be a good bet that a chisel or something similar will fall and land on them, cutting edge first!

Series

When connecting sockets, etc., there are three ways in which this can be done. One is known as 'series', the second, 'parallel' and the third 'series-parallel'. If things are connected in series then the voltage across them will be divided by the number of items connected. If we have two lamps connected in series the light given will be very dim as the voltage through each will be half that of the supply. If two bulbs designed for lower voltage are put in the sockets then they will each give off the full light.

Parallel

It now becomes fairly obvious that when we connect up two or more sockets, from which it is proposed to operate electric motors, we cannot connect them in series as they will only receive a proportion of the voltage and so will not function properly. All such connections therefore must be made in parallel. Another disadvantage of making connections in series is that, if one item in the chain fails, then none will work as the current has no means of passing the failed unit.

Series parallel is the name given to a circuit where some items are connected in series and some in parallel and is not really

the sort of thing with which we are likely to be concerned at this stage.

Ring mains

When wiring workshops, sockets should if possible be formed in what are called 'ring circuits'. This is a system where all positives or line terminals are connected to each other and then returned to the positive output, and likewise with the negatives. The advantage of this is that, as current flows along a wire it loses some of its power. Thus, when we connect four sockets the fourth in line will receive slightly lower voltage than the first one. If the wire is continued back to the positive terminal, however, current will also flow to the fourth socket from the terminal without passing through the other sockets first and the result will be the maximum efficiency.

Position of sockets

If wiring up a workshop, give plenty of thought to the positioning of sockets. About waist-high is ideal but it's really a matter of personal choice. Make sure that there are sufficient sockets available and avoid the use of plug-in two or three way sockets. It's far better to get a lead with double or more sockets on it and use that. All circuits should be protected by adequate cut-outs that will trip as soon as anything goes wrong.

Safety cut-outs

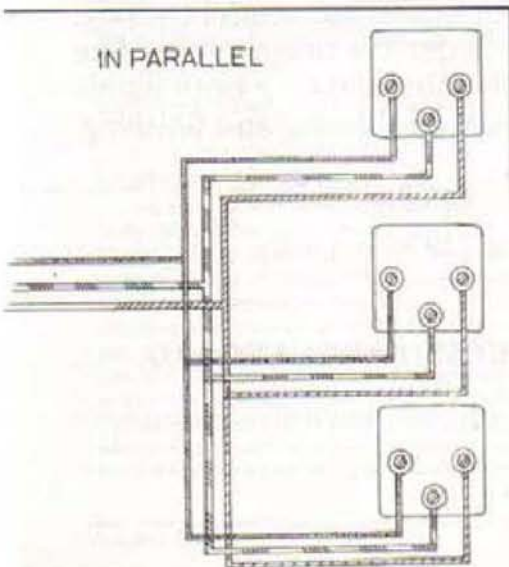
Lighting and power circuits should always be wired separately, and should also be protected with a cut-out trip switch of a suitable rating for the power to be used. The wire used for wiring circuits must be of adequate thickness to carry the full current and an electrical dealer can supply details of the thickness of wire needed for such purposes.

Low voltage circuits

All electricity is potentially lethal and the higher the voltage the more dangerous it is. For this reason, in industry, lighting is limited in the close vicinity of machines to very low voltages. There is no reason why this should not also happen in the home workshop and elsewhere in this issue we will be showing how to make such lighting. If low voltages are to be used, a separate circuit will be needed and it is worth considering wiring in such a circuit. Nowadays it is easy to obtain low voltages such as a twelve volt supply. A transformer is needed and as we will almost certainly use dc we include a rectifier as well to convert the current from ac to dc. This will allow small motors also to be used on the circuit. A suitable means of transforming the current can be by using a motorcar-type battery charger in the circuit. Failing this, it is possible to purchase units if required. For the use of plug-in components pay a visit to the local caravan dealer; they stock small plugs and sockets and those suitable for lighting are very cheap to buy.

That is very briefly a survey of electricity! We have not gone deeply into the matter but hope there is sufficient grounding to be able to progress in the future to electronics, and explain what the components do so that readers can make use of the various articles we have in the pipeline for you. Electronics are not difficult to grasp and anyone can soon get a basic knowledge which will enable them to build useful equipment.

IN PARALLEL



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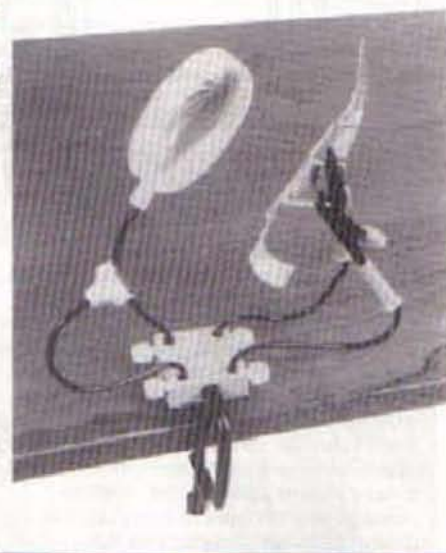
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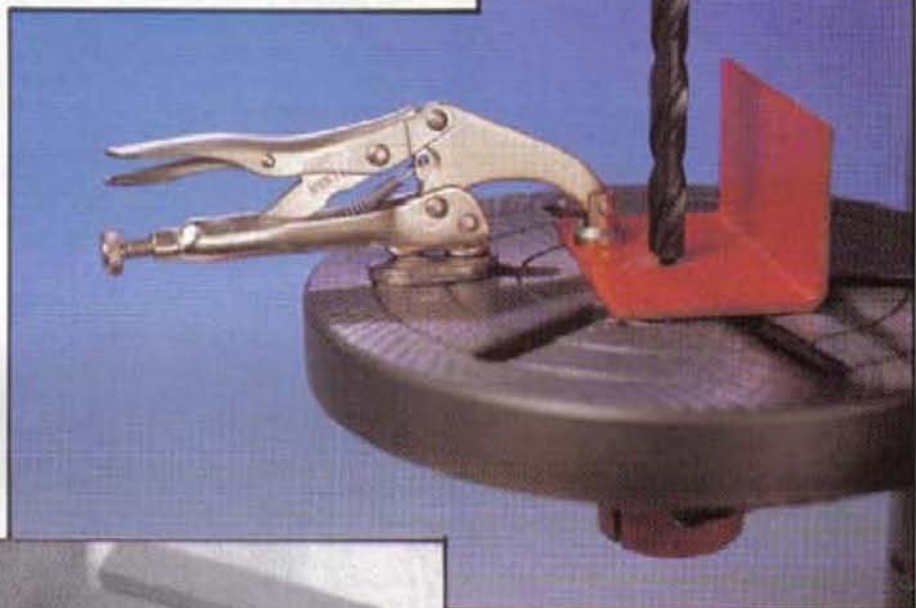
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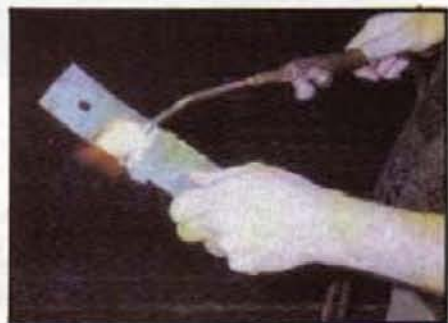
A brief selection of new items and workshop ideas of interest to readers; we'll bring you more in future issues as we hear about them.

Drawings & castings

We have received some drawings and sample castings from Metal Lathe Accessories, Town Farm, Outwood, Bletchingly, Redhill, Surrey RH1 4LR. The firm specialises in accessories designed for the Southbend lathe, but no doubt the designs can easily be adapted for other lathes of similar proportions. There are twelve different designs available including such things as a ball turning attachment, reversible milling base, tee slotted cross slide, etc. The drawings and castings are of the highest possible quality and constructional details are included. For anyone hoping to extend the capabilities of a lathe of this size they are very useful indeed. The drawings and castings are actually produced in the U.S.A. and so there may be a slight delay between ordering



Above, the useful vice clamp spotted at Jack Sealey Ltd. Left, Metal Lathe Accessories' ball-turning tool in use. Below, an interesting item from the Frost catalogue. Called 'Cold Front', it is painted onto metal to prevent heat transfer - as illustrated by this spot of hand-held oxy-acetylene work!



and receiving supplies. But orders are dealt with immediately upon receipt and so this should not be too long.

Useful catalogue

We were sent a catalogue from Frost Auto Restoration Techniques Ltd which, at first, hardly sounded the type of thing to interest model engineers. Upon browsing through it, however, we found a considerable number of items which are not generally available which would be of use to model engineers, and most certainly to the home workshop enthusiast. These included a roller cutter which, at a glance, seems to be a considerable improvement on the normal bench shears. There are self-

starting stepped drill bits which allow the cutting of large-diameter holes without tears. Another item that would be of interest is edge grips for holding two pieces of sheet metal together while working on them. Add to this, punches, metal folders, rollers, and a whole host of other things and it makes one realise that this is an area worth looking into for special bits of equipment. The catalogue costs £1.00 from Frost Auto Restoration Techniques Ltd., Crawford Street, Rochdale, Lancs OL16 5NU.

A vice clamp

Whilst visiting the Jack Sealey premises there were many items that took one's eye

that would be useful in the workshop. These included safety equipment, hand tools, machinery, etc. Something that was of particular interest, however, was a drilling machine clamp based on the well-known mole type of grip. Fixed to the table of the drilling machine it provides a particularly secure means of holding work and, if properly adjusted, one clamp will hold the work on its own. A simple form of wing nut secures it to the drilling table. It has been tried at length and has been found to be an excellent piece of equipment which is really useful in the workshop. It is available in different sizes from any stockist of the Sealey range of products.

WELCOME TO THE WORKSHOP...



Arthur Casebrook is slightly disabled and eighty one years of age. Not prepared to sit back and let the world pass him by, he pursues his hobby of model engineering in a workshop which he shares with his son. Much of the time he is alone and so has made a number of modifications and adaptations to suit his own particular circumstances. This is a brief look at his ideas.

Left, Arthur's workshop is a small brick building which has been extended. Below, storage of small tools is in neat cupboards with doors which help keep rust off the equipment.



Use of tobacco tins for small part storage is common; Arthur's variation on the idea is to colour code his to denote type of content.

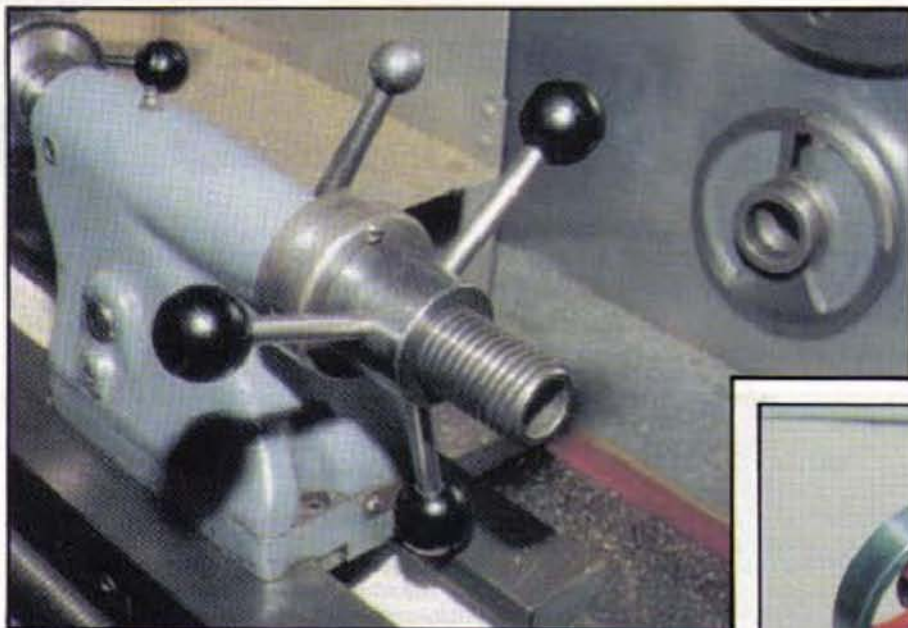
Arthur cannot recall a time when he was not interested in modelling in some form or another, mainly small gauge railways and boats. He has a considerable knowledge of radio control and in the days of valve-driven radios he wrote a book on the radio control of models. Later in life he started to become interested in model engineering rather than just model making and decided to build a workshop, in order that the equipment should have a permanent home.

He still lives in the house in which he was born, which is a terraced cottage. The arrangement of the garden is, to say the least, unusual as a footpath used by all the tenants of the row of cottages runs across it. The building chosen for the workshop was an old outside storage room made of brick in which previously he had kept his motorcycle. Later this was extended with the moving of an old brick-built summerhouse from the other side of the garden.

Whilst unlikely to win prizes for appearance on the outside, it is a picture of neatness and organisation inside!



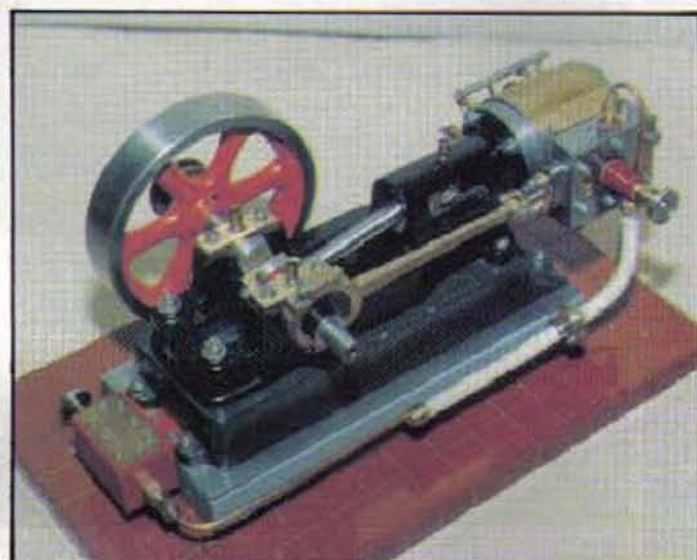
Lathe equipment is stored on specially designed open shelves near the machine.



A close-up view of the lathe tailstock showing the capstan type handle.

included in the electrics, and the workshop itself has been made as secure as possible. A two-way intercom system enables Arthur to communicate with his wife in the house, this being mainly intended for the possibility of her not feeling too well as she is a semi-invalid – but it is also a useful device for knowing when tea or lunch is ready! There is a panic button in the workshop so that if the occupant feels unwell he can summon help.

A cylinder of compressed air is used for



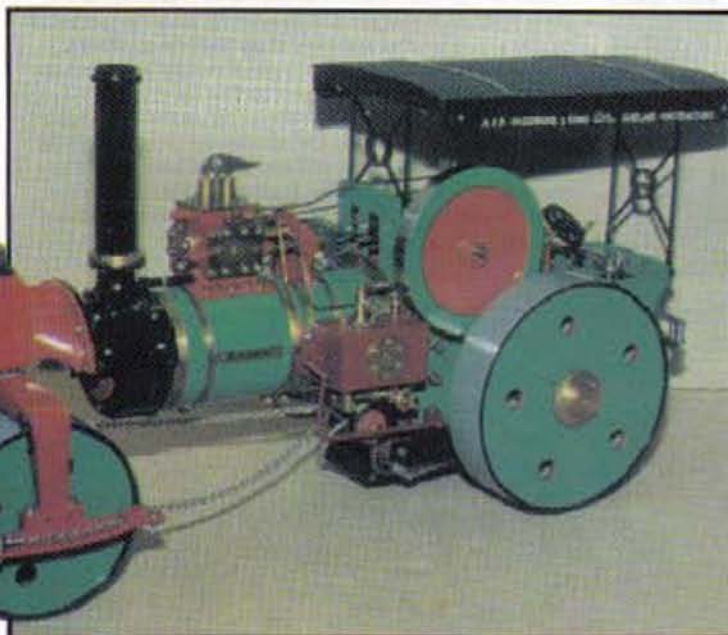
The M.E. Convertible Roller is one of numerous models made by Arthur and his son.

Without the special workshop modifications described, construction of this model mill engine would not have been possible.

running models and this is refilled by the British Oxygen Company, who collect and deliver when requested. A small toggle press is another unusual item which is used for a variety of purposes. A most unusual aspect is a stock-control system that Arthur uses to keep track of exactly what material is available for use and, in this way, he and his son know when to order new material.

All forms of heat treatment and soldering are carried on elsewhere to prevent the formation of rust caused by the rapid heat changes and flux fumes, the latter being particularly hard to prevent when soft soldering.

We are indebted to Arthur and Barrie for allowing their workshop to be photographed and described, and hope that readers may glean some ideas from this inventive pair of model engineers.



Everything has its place and a lot of thought and care has gone into the layout. A series of narrow cupboards on the walls serve the dual purpose of keeping everything in place and preventing rusting.

An elderly Myford lathe is used extensively both by Arthur and his son who shares the workshop. Because he cannot now grip things, several modifications have been made to this to enable him to operate it.

The drilling machine, which is a comparatively recent acquisition, is permanently fitted with a compound vice. This allows the drilling of co-ordinates and means that no finger strength is required to move work over short distances.

With son Barrie being a qualified electrician, good electrical wiring systems are inevitably part of the workshop equipment. The workshop is somewhat vulnerable so a loud burglar alarm is



The chassis for 'Dyak', a 2 1/2 inch gauge locomotive; boiler construction will take place in a separate building to avoid condensation.

A SIMPLE TREPAN

Cutting large diameter holes in very thin sheet metal can be a problem. This little trepanning tool does the job very well and is easy to make. Remember, though, the work must be held securely on all four corners to prevent the tool from forcing it round.



At left, drilling and turning the boss on the body of the tool can be carried out in the four-jaw chuck. Below, both holes in the body that go lengthways can be drilled in the four-jaw chuck by simply moving the piece over to drill and tap the second hole. Bottom right, the tool shaft and adjuster – all simple, straightforward turning operations apart from milling the slot along the tool shaft which can be done with a milling cutter held in the lathe chuck while the shaft is secured to the cross slide. If no milling facilities are available, an alternative is to file a flat on the tool shaft about $\frac{1}{8}$ in. or 3mm wide and butt the securing screws against that. In order to cross-drill the hole for the tool (see illustration at lower left), the shaft is held in the body with two screws; the work can then easily be lined up by eye while drilling takes place. Make certain, however, that the hole is started with a centre drill to prevent the drill from wandering out of line.



WINNING TOOL

There are a number of ways in which large diameter holes can be cut in thin metal sheet. One obvious means is to drill a row of holes, the peripheries of which nearly touch each other, around the inside of the required circumference. Break out the piece in the middle and then file the hole to shape. Careful workmanship can result in a perfectly circular aperture but the process is time-consuming and irretrievable mistakes can easily be made.

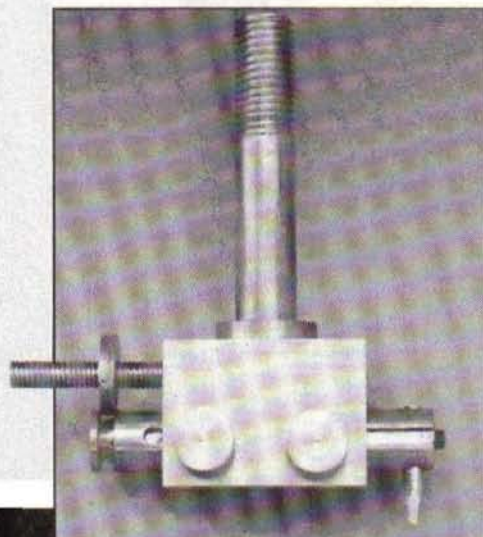
Special tools can be purchased which will do the job. For smaller diameters, simple spade type drills are available and for larger ones it is possible to use some of the patent tools which can be purchased or one can quite easily make one's own tool.

The process of using a tool such as that about to be described is called 'trepanning'. Quite simply, an ordinary cutting tool is made to rotate to the circumference of the required circle and slowly cuts through the metal.

Tools known as 'tank cutters' can be bought or made which will do this work, and they consist of an adjustable blade in a bar with a twist drill in the centre. The twist drill is run into the metal and acts as a pivot for the cutting tool which then cuts through the metal. They are not often used these days as other tools now take their place, and for precision engineering were never the best tools as the twist drill was inclined to wander and throw the cutter out of position.

If the metal is firmly secured to the drilling table or milling machine then no

The finished tool; the lack of a drill in the body centre makes it easier to mount work that is to be machined, as only a thin section of wood or hardboard is required underneath it as a support. With a drill mounted in the body, a much deeper mounting area would be called for. There is a centre mark on the base and this allows initial work setting with dividers set between the centre mark and the tool cutting edge. Make the required hole undersized and use the adjuster to get it to exactly the correct diameter.



twist drill is needed, the rotating cutting tool being capable of cutting a very accurate circle.

The body

The body of the tool shown is made from a piece of mild steel bar stock. A hole is drilled along the length of the stock to take the cutter bar. This drilling should be done with the body held in the four-jaw chuck in the lathe to ensure accuracy.

It will be seen from the drawings and photographs that another hole is drilled and tapped slightly above the first one (which is below centre height). This second hole is to take the adjuster screw.

The work is then laid the other way in the four-jaw chuck and the hole for the shank drilled; it can, if one wishes to lighten the tool a little, also have a boss turned round the edge of the hole.

The shank

The shank is brazed into the body. It can either be parallel or made with a morse taper to fit the lathe, drilling, or milling machine mandrel. The one shown has been threaded and centred to fit a collet chuck, which gives another option. There is no reason why, if one so wishes, the shank should not be turned from a solid piece of metal integral with the body.

The tool bar

The tool bar is made from mild or silver steel. It is simply faced at each end and cross drilled to accept the tool. A small slot is milled along it and screws through the body located in this and prevents it being forced over when cutting is taking place. The width of the slot should suit the diameter of the screws. The screws shown in the illustration are brass and knurled. The threads must be good or the screws will shake loose in operation. A good alternative is to use Allen-headed grub screws which will fit right into the groove. It is essential that they do fit right home as, if they touch the tool bar, burrs will be raised and this will prevent it moving. Another small slot is cut around the bar to accept the adjuster.

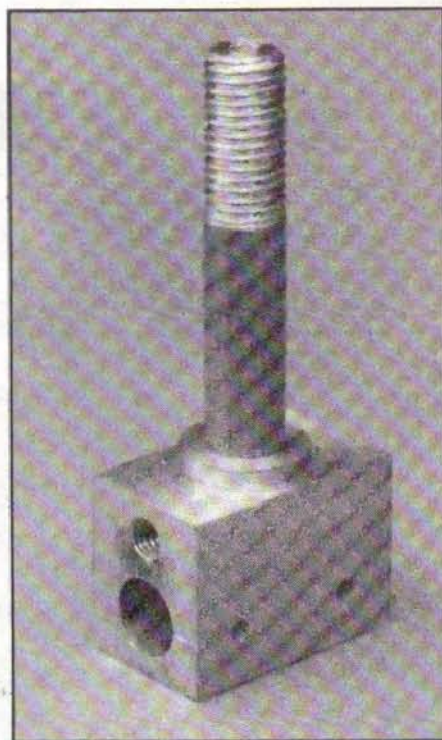
The adjuster

The adjuster is a threaded round disk which screws on to a piece of studding in the body. The studding should have a thread that allows a check to be kept on the movement of the adjuster. For those using metric measurements, a pitch of one or half a millimetre is ideal. In the case of Imperial measurements, I would suggest thirty two threads per inch.

If these threads are adhered to, one complete turn on the metric thread will advance the cutter one or a half a millimetre, and simple graduations of which there need only be four, will allow for small movement. With thirty two threads per inch, one complete turn will advance the cutter by a thirty second of an inch, half a turn, a sixty-fourth and so on.

The cutting tool

The cutting tool is a piece of high-speed



The body and shaft, or shank, of the tool; the shaft is silver soldered into the body. In this case, the shaft has a thread on it to allow it to be secured in an Osbourne chuck. However, a plain shaft will do just as well but be warned that, even with the lightest of cuts, considerable force is involved and there is a real danger of the tool twisting in the chuck or collet.

steel, but hardened and tempered silver steel would also do the job. The cutting point is on the outside of the periphery of the cut which gives a nice vertical edge to the hole. Although the tool shown has a round cutter, an improvement would be to use a piece of square material as there is a slight tendency for the cutter to twist in operation. It must be thoroughly tightened up when the tool is in use, as the forces acting on it are large and it must be absolutely secure.

Using the tool

In use, the trepanning tool is run at a very slow speed and brought on to well secured work with a piece of hardboard or similar material underneath it to protect the machine table. It will slowly cut a circle of the required diameter. Good lubrication of the work is essential in order to obtain a good finish.

Drawings overleaf

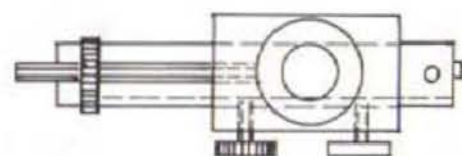
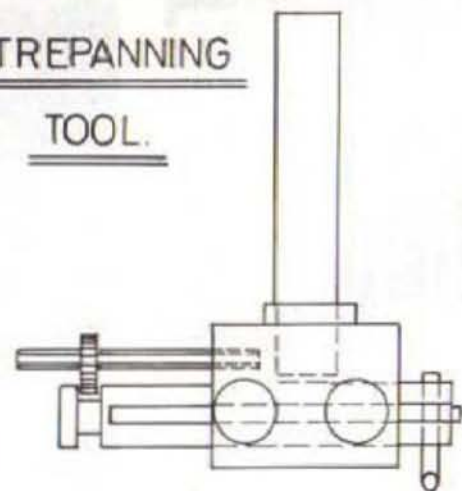
QUICK TIP

From Stan Wade of Guisley, Leeds the following tip.

Instead of discarding old telephone directories, hang them in the workshop on a couple of nails. This is a cheaper alternative to using paper kitchen towels!

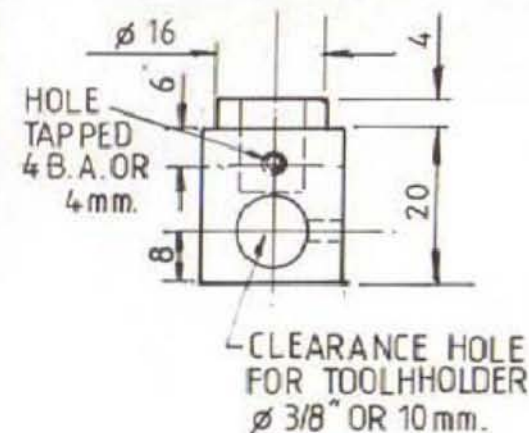
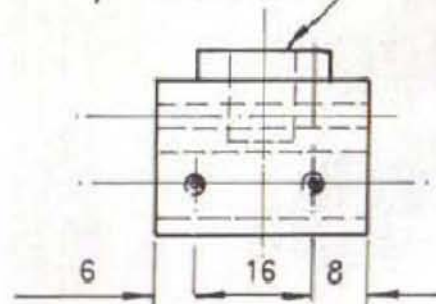
TREPPANNING

TOOL.

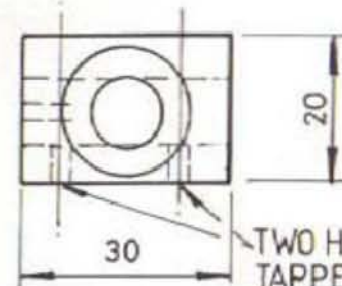


ADJUSTER STUD
4 B.A. OR
4mm THRD x 40 LONG.

HOLE FOR SHAFT
Ø 3/8" OR 10mm.



BODY, ONE OFF
MILD STEEL.



TWO HOLES
TAPPED 4 B.A.
OR 4mm.

TAP 4 B.A. OR
4mm

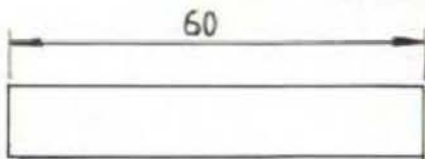
LIGHT KNURL

MAKE NICKS
TO GIVE GUIDE
TO ADJUSTMENT

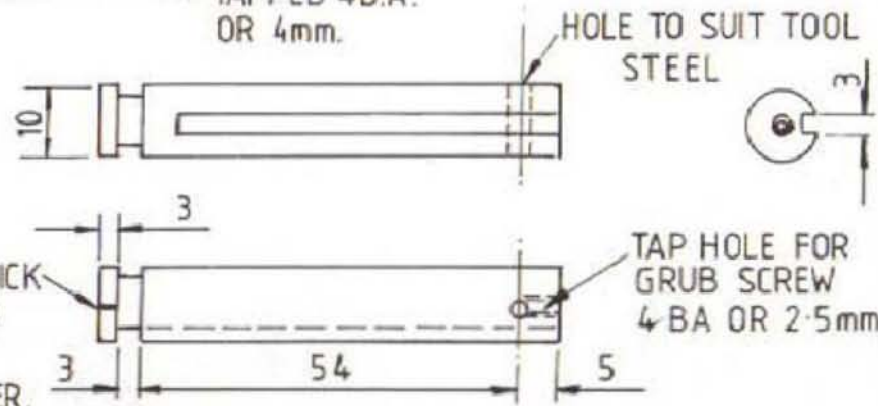
MUST BE A
CLOSE RUNNING
FIT IN SLOT IN
TOOL SHAFT.

KNURL

SECURING SCREWS 2 OFF
BRASS
THREADS TO SUIT BODY,
END DIAMETER TO SUIT
SLOT IN TOOL SHAFT
OR USE SKT. HD. GRUB
SCREW.



MAKE NICK
HERE TO
ALIGN
ADJUSTER.



TAP HOLE FOR
GRUB SCREW
4 BA OR 2.5mm.



SHAFT 10mm OR 3/8" DIA. MILD OR SILVER
STEEL SILVER 10mm INTO BODY.



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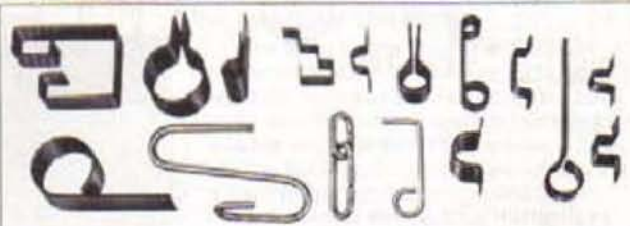
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Several years ago, I bought a second hand floor-standing vertical milling machine. Mounted on the side was a mains lamp with a sixty watt bulb. The lamp was fixed with a gooseneck device, a form of flexible metal tubing, frequently used for microphones, etc. The lamp was large and cumbersome, and I was aware of the danger of accidentally poking a piece of metal in it whilst working. I also kept burning myself on it!

The first experiment

In an attempt to improve this I experimented by replacing the mains system with a twelve volt, six watt motor-car bulb, in a small homemade aluminium reflector. It certainly solved the heat problem and was much less bulky, but the light given was poor, the bulb quickly became blackened and the light output was further reduced.

Stage two

Browsing through a catalogue by Tandy who have electrical shops in most towns, I noticed a small halogen lamp. It was type HPR 50 and was flange mounted, six volt nominal. I was not able to find a suitable

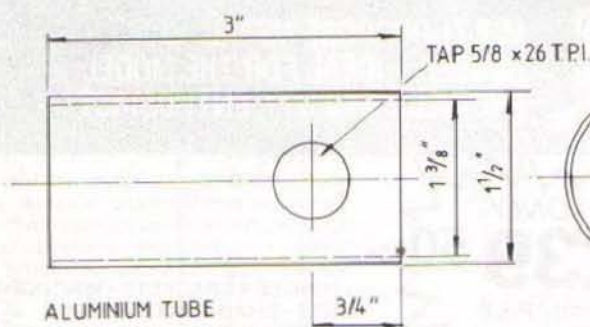
Below, the halogen bulb for the six volt unit with the holder and plunger. Here (right), the outer plastic ring and end cap have been added to the bulb holder.

LOW VOLTAGE LIGHTING

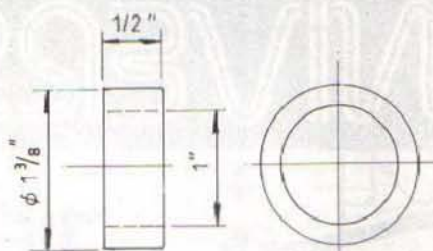
Good lighting at machinery is essential; this, as older readers will know, applies particularly as age overtakes us and eyesight becomes a little less sharp than it was, but it is also essential for younger people. Good lighting not only assists in good workmanship but also in safety – it becomes easier to see potential danger when the scene is well lit. Most people probably use some form of mains lamp which is adjustable and can be brought near the work. Whilst certainly supplying enough light, particularly if used with modern reflector type bulbs, mains lamps can be dangerous and cumbersome. It is all too easy to bang one's hands on the lamp whilst working, and the heat transmitted by the lamp can be uncomfortable. With this in mind, our contributor 'Bluey' set about organising some low-voltage lighting in his workshop, and tells us how he did it.



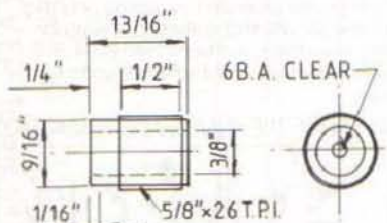
6 VOLT MACHINE LAMP



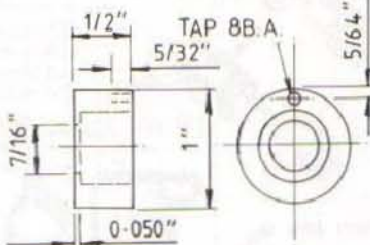
ALUMINIUM TUBE



INSULATOR MAT^L TUFNOL



BULB RETAINING MAT^L TUFNOL



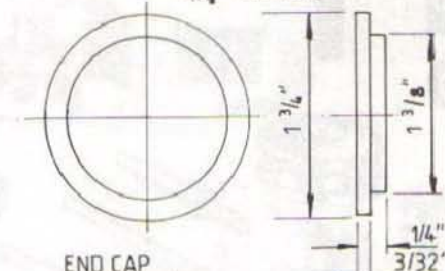
LIGHT SPRING.



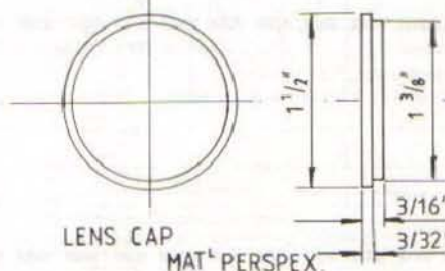
PLUNGER CONTACT MAKE FROM 6 B.A. SCREW



BRASS STUD 6 B.A.



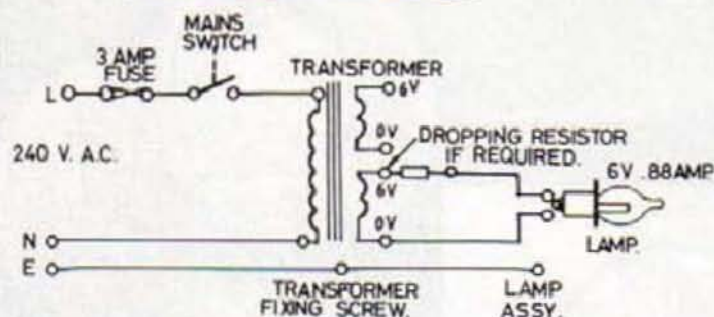
END CAP MAT^L ALUMINIUM



LENS CAP MAT^L PERSPEX

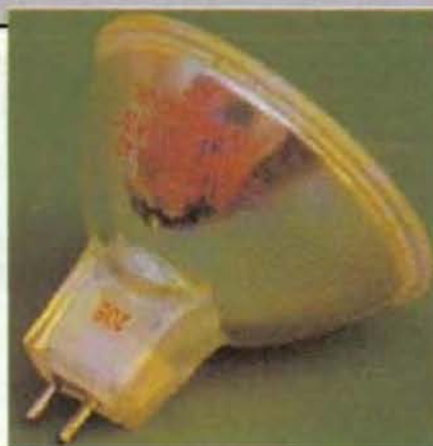
©

6VOLT LAMP CIRCUIT.



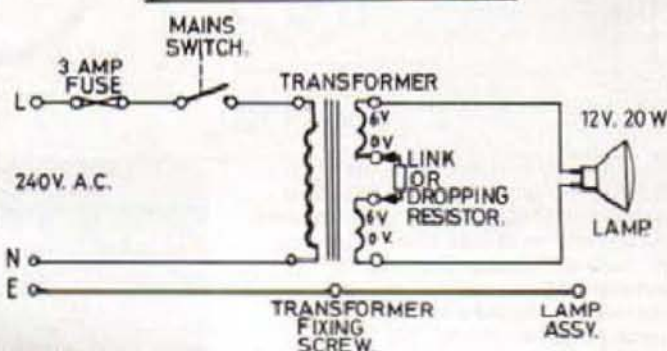
NOTES:-

- 1/FUSE & SWITCH FOR 12VOLT LAMP
- 2/TRANSFORMER 240V INPUT, OUTPUT 2 SEPARATE WINDINGS OF 6VOLTS AT 1 AMP ONLY ONE USED
- 3/DROPPING RESISTOR A .330HM RESISTOR WILL DROP THE LAMP VOLTAGE BY .3VOLT, A .470HM RESISTOR BY .5VOLT THE RESISTOR NEEDS TO BE RATED AT 3WATTS OR MORE.
- 4/ THE LAMP IS 6VOLT .88AMP NO OTHER LAMP SHOULD BE USED WITH THIS CIRCUIT



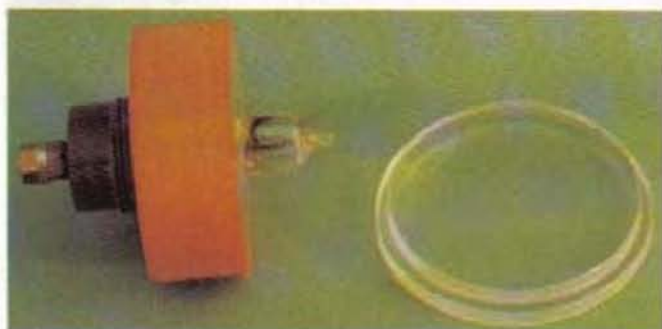
The twelve volt bulb which comes complete with lens; note those pins for which a holder could not be obtained. Wires, however, can be soldered to them easily.

12VOLT LAMP CIRCUIT.



NOTES:-

- 1/ 3 AMP FUSE CAN BE FITTED TO 13 AMP PLUG
- 2/ MAINS SWITCH ANY SUITABLE MAINS LIGHTING SWITCH.
- 3/ TRANSFORMER 240V. INPUT OUTPUT 2 SEPARATE WINDINGS OF 6VOLT AT 2AMPS.
- 4/ DROPPING RESISTOR, A .220HM RESISTOR WILL DROP THE LAMP VOLTAGE BY ABOUT .37VOLT. A .330HM RESISTOR BY .55VOLT THE RESISTOR NEEDS TO BE RATED AT 3 WATTS OR MORE.
- 5/ THE LAMP IS 12VOLT, 20WATT NO OTHER LAMP SHOULD BE USED WITH THIS CIRCUIT



Top left, the bulb in its holder and the outer ring together with lens cap machined from Perspex. Far left, the six volt unit slipped into the aluminium tube. Near left, the outer casing of the twelve volt unit showing how the inner portion was machined to accept the unit. Note also how the tube is bored to accept the gooseneck. Below, the split ring and the end cap with the twelve volt halogen bulb unit.

holder and so set about making one complete with reflector. The reflector was made from a three inch length of $\frac{1}{2}$ in. diameter aluminium tubing with a wall thickness of $\frac{1}{8}$ in. The end cap was turned from a piece of $\frac{1}{2}$ in. thick aluminium plate and a lens made from a piece of Perspex sheet.

A bulb holder was made from a piece of Tufnol with an aluminium insert. A bulb clamp was also made from Tufnol and it contained a brass spring plunger type contact. The clamp was threaded to screw into the aluminium insert. The whole assembly was mounted on the gooseneck and proved to be very satisfactory, producing an intense white light. It was cool and, of course, being only $1\frac{1}{2}$ by 3 in. it was not at all bulky.

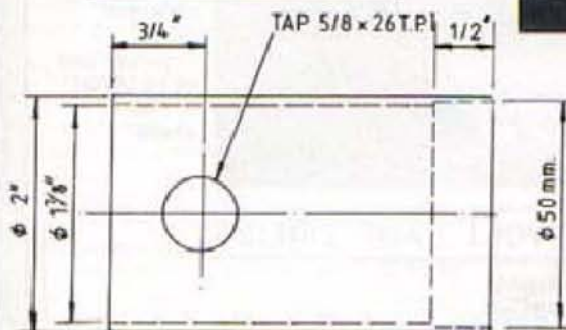
A lamp for the lathe

The lamp on the lathe was a clip-on holder containing a miniature forty watt reflector lamp and this served its purpose quite well for many years, but I thought it in need of improvement. In a catalogue from Wickes Building Supplies I saw advertised a low voltage lighting range, and began thinking about utilising it for the lathe. Goosenecks were available quite cheaply from Maplin Electronics whose catalogue can be bought in good newsagents. So from Wickes I bought a narrow beam ESX



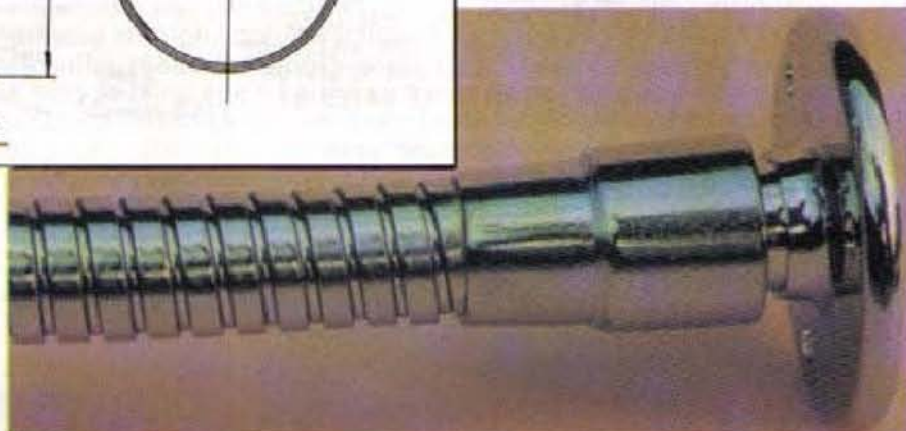
Right, the twelve volt unit with the bulb and gooseneck in place. Below right, a gooseneck with a flange fitting for mounting purposes.

12 VOLT MACHINE LAMP



ALUMINIUM TUBE

12 volt twenty watt halogen lamp which comes complete with reflector and clear cover (a wide beam version is also available and is classified as type BAB). The bulbs are made by Sylvania. The reflector diameter is 50mm nominal and, upon measuring it, I found it to be 0.15mm oversize in places. As this was due to mould flashing I carefully trimmed it round using a flap wheel running at high speed in the drilling machine and rotating the reflector by hand.



The six volt unit mounted on the milling machine; note flexibility and neatness of assembly.

The gooseneck came from Maplin Electronics and, in this case, was thirteen inches long. It has a $\frac{1}{2}$ in. male thread on one end and a similar female thread on the other which is intended to screw into a base. A suitable lock-nut was made up to connect the gooseneck to the lamp housing.

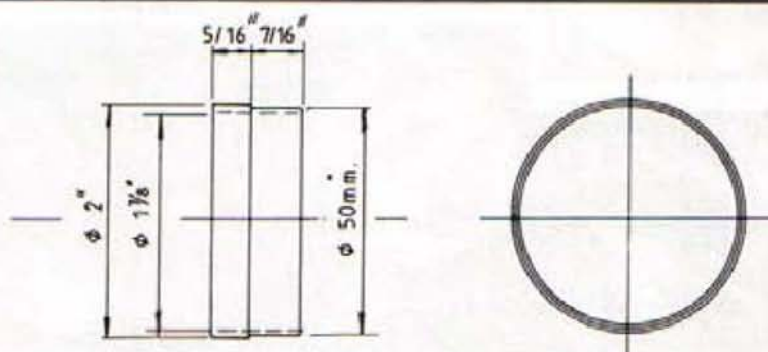
The finished result is a neat little lamp that leaves plenty of room round the machine and does not give off a great deal of heat. It is easily adjustable, with the minimum of effort.

Notes on quartz halogen bulbs

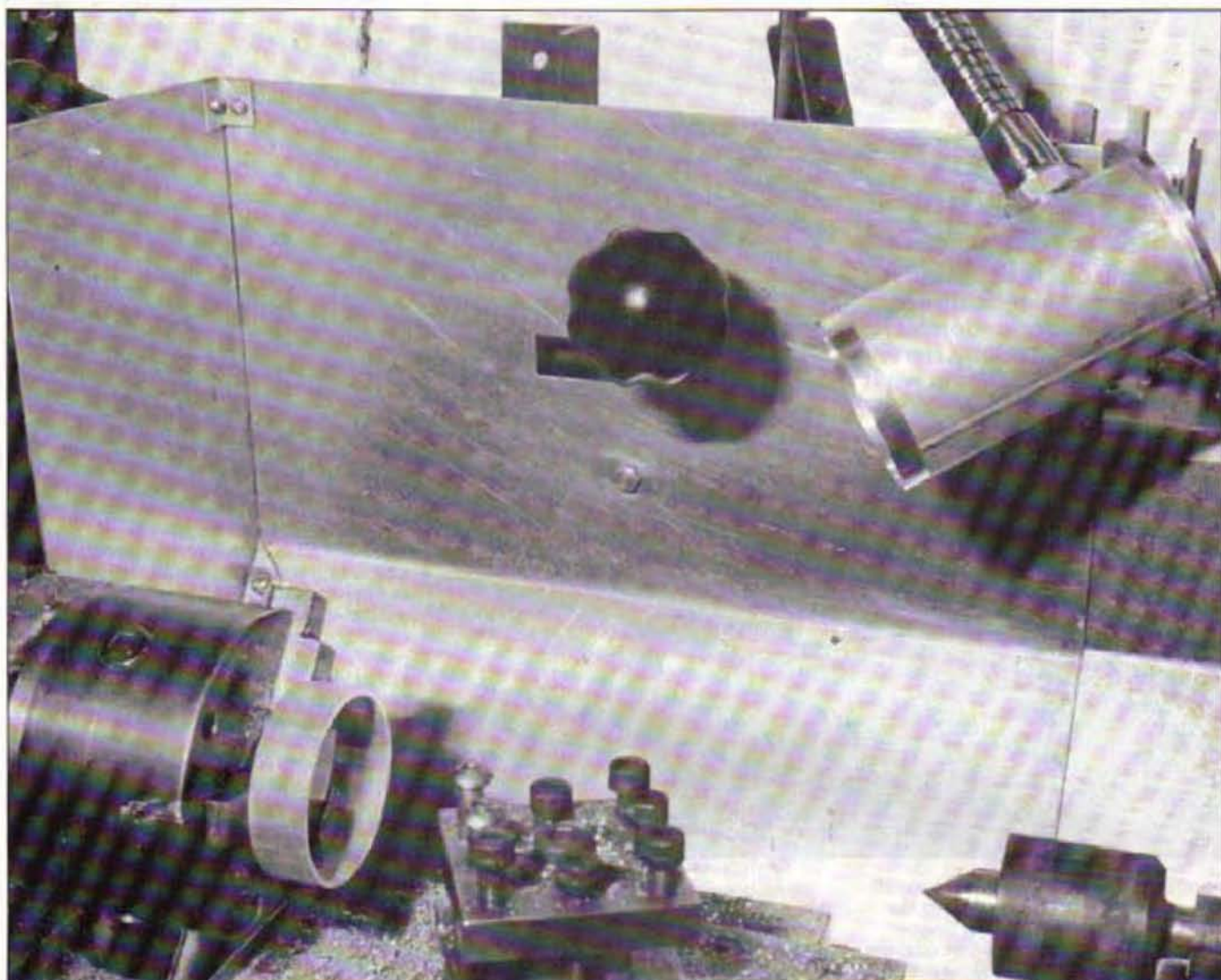
The glass envelope on a quartz halogen bulb must never, under any circumstances, be touched by hand. Doing so will leave a deposit which is detrimental to the bulb and will considerably shorten its life. If it must be touched then it should be done whilst holding a paper tissue in the hand or the hand should be enclosed in a glove.

The lamp cover

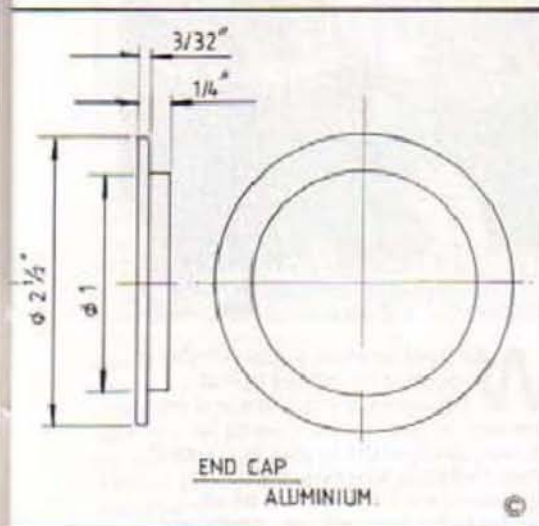
A piece of 2 in. diameter aluminium tube with a wall thickness of $\frac{1}{8}$ in. was the nearest I could get in size and a piece of this $3\frac{1}{2}$ in. long was mounted in the lathe and for a length of $\frac{1}{2}$ in. was bored to 50mm diameter. A retaining ring was made from a piece of the same tube turned to an outside diameter of 50mm and $\frac{1}{8}$ in. in length for a push fit in the main tube. An end cap was made from $\frac{1}{2}$ in. plate turned 2 in. diameter and also a push fit in the tube. This also acts as a heat sink and helps keep the lamp cool.



BULB RETAINING RING
ALUMINIUM



The twelve volt lighting unit on the lathe; the bulb gives as much light as a sixty watt mains bulb, generates little heat and is easily adjustable.



The reflector type bulbs bought from Wickes are totally enclosed and so there is no need to worry about those.

At too high a voltage the life of these bulbs is considerably reduced. If the voltage is too low then the light given off is a yellow colour and much diminished, not at all suitable for the purposes I have described. It is essential that the correct voltage or very slightly under be used to produce a good light with maximum life for

the bulb. The reflector type bulb needs a special two-pin connector which I was not able to purchase. I did happen to get a suitable one but it is unlikely that readers will be able to do so. The connections will therefore have to be made by soldering wires to the bulb pins.

Transformers

Obviously, if low voltage lighting is to be used, a transformer will be needed. For the smaller lamp a six volt transformer is available from Maplin Electronics, under the code number YJ 50 E. It has two six volt one amp windings, but only one is used. The larger lamp needs a twelve volt transformer rated at least two amps. A suitable one can again be obtained from Maplin, code number YJ 51 F. This has two six volt two amp windings which are coupled together to give the twelve volt two amp output. It can be checked with a voltmeter and if the output is too high a resistor can be fitted in series between the transformer and the lamp. As mains voltages vary considerably throughout the country the resistor size will need to be varied accordingly. In my own case I used a 0.22 ohm, five watt resistor, with the twelve volt transformer to get the required twelve volts.

Safety

The transformer must be mounted in such a way that it cannot be touched, as there are mains voltages at the terminals; this means enclosing it in a box, which can either be bought or made. It must be fused with a maximum fuse of three amps and the fuse can be carried in the mains plug. The system must be earthed; the transformer has a suitable terminal but a wire must be taken from the gooseneck in order to earth the lamp unit. To prevent overheating, some form of warning light should be fitted to show when the transformer is switched on in order that it is not accidentally left on. A mains plug with a suitable warning light can be obtained and would suit the purpose nicely.

Suppliers of suitable equipment

Maplin Electronics, P.O. Box 3, Rayleigh, Essex SS6 8LR. Telephone: 0702 552911
Tandy, High Street shops throughout the country.

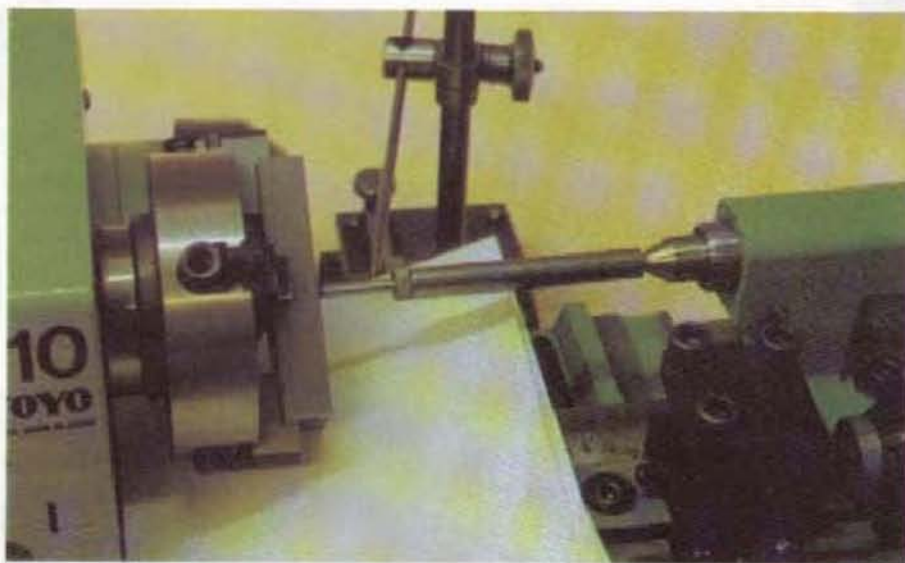
Wickes Building Supplies, Warehouses throughout the country, usually situated on industrial estates.

Aluminium Stockists: Simmal Ltd, Unit 479-480 Walton Summit Centre, Bamber Bridge, Preston PR5 8AX. Telephone: 0772 324277.

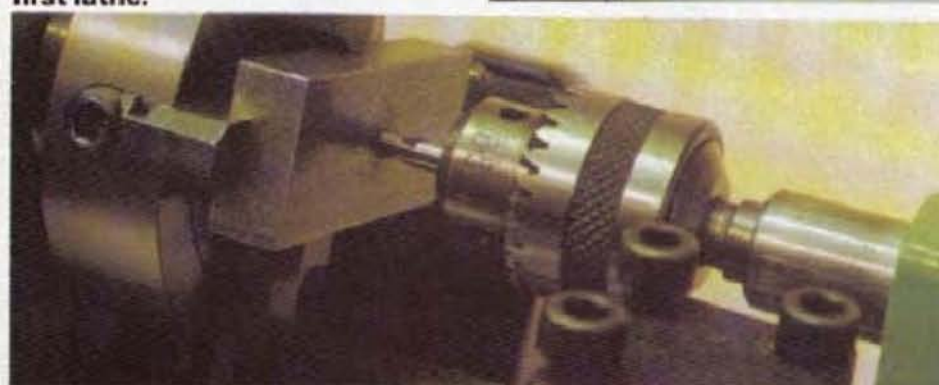


TYRO TIME

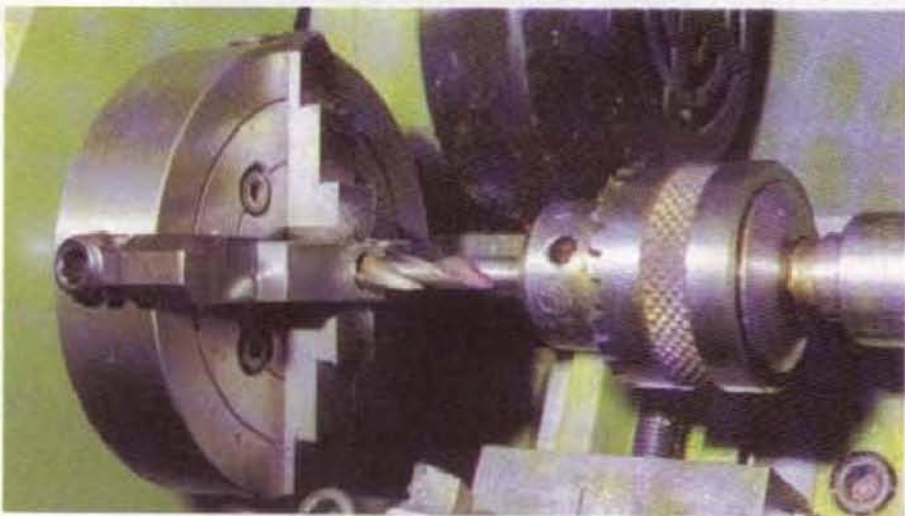
Results from our readers' survey in the last issue highlighted a need for basic information for newcomers to the hobby. Here, for beginners, is the first in what will be a regular slot in MEW covering first steps in workshop practice. This time we'll take a look at getting started with that first lathe.



To make the centre height gauge, mark the base with a centre punch and, using the centre finder, adjust the metal in the four-jaw chuck until it is true. A scribing block is used to gauge the accuracy with a piece of plain paper behind as an aid to visibility and, for those who have never done this before, it is simply a matter of adjusting the chuck jaws until the centre finder runs perfectly true against the scribe. You should practice this procedure as frequently as possible to improve your ability in making these adjustments.



Above, start the hole with a centre drill; never attempt to drill directly into the metal without first using this. Below, drilling the hole in the base ($\frac{1}{4}$ in. or 6mm diameter) after using the centre drill. Note that a short series of stub drill is in use; a normal length drill of this size is really far too long for a small lathe and has a tendency to wander off line. At right, after centre drilling, use the stub drill to make the main hole. Note that, to get the work in the chuck, one jaw has had to be reversed.



We have received a large number of requests for articles to help beginners to the hobby and we have also received many requests for articles relating to the smaller or compact lathes. Generally speaking, good engineering work starts at the bench, learning to file, saw, drill, etc., neatly and accurately. All the top model engineers are experts at this sort of work. People who buy lathes, while no doubt recognising the fact that such skills are necessary, read a magazine such as this because they are anxious to get on and use the machinery which they have obtained. We will therefore be covering handwork in the magazine and describing how to get the best from hand-tools, etc., but this will be done as part of other articles in the main, rather than as separate ones in their own right.

Here we make a start with lathe work for the beginner, and try to offer some advice on how to go about things to get the best from the machine. The subject is wide and it is not possible to cover it all in one issue, so whilst each article will be complete in itself, there will be others following that will enable readers to add still further to their ability to use a machine, whether it be a lathe or a milling machine. In this first one we try to point out the pitfalls that can occur to those who do not quite know how to start machining-operations.

Tyro time

Having obtained one's first lathe, the urge is to get on and use it! To many, this will mean inserting a piece of material in the three-jaw chuck, putting in a lathe tool and seeing how fast the metal can become a pin. The result usually is something more like a corkscrew! Why does this happen? we must ask ourselves. The answer is to first of all understand the machine we are about to use.

Safety

The first thing to remember is that all machinery is dangerous to some degree. It is not exactly like experimenting to see if we can make a model from Semtex, but there is a danger! Flying pieces of metal can cause damage to the eyes, as well as nasty little burns if they land on tender flesh. It makes sense to wear safety glasses, which can be bought very cheaply, and to cover up those sensitive parts where flying metal might land. This complicated manoeuvre really means buttoning up ones shirt, and discarding those lovely multicoloured Bermuda shorts which auntie gave us for Christmas, in favour of a pair of trousers...



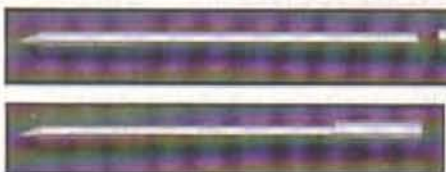
For people using small lathes like the Toyo 210 the picture above illustrates a useful little idea. The normal Allen key used for removing and tightening the chuck can be cumbersome and get in the way. Take a short length of $\frac{1}{4}$ in. (3mm) diameter mild steel and drill a hole in the end the diameter of the across flats size of the key. Cross drill it for a handle about 3mm diameter. Cut the Allen key and force a short length into the hole in the mild steel. Put a piece of mild steel across to act as a tee handle. (About the same length as the $\frac{1}{4}$ in. diameter mild steel bar is right.) The key can now be used with sufficient pressure but will not get in the way. The photograph shows how a further improvement has been made by putting plastic tubing over the handle.

At right, the parts required to make the point on the centre finder. The larger diameter piece can be secured to the actual point with Loctite 601 or a similar retaining compound.

Lower right, the point as assembled. An alternative would be to turn the part from solid material.

happen in the home workshop. It makes life that little more awkward. So whilst they *should* be used (and some are, no doubt), no matter what is written here most will not have a guard fitted. A lot of people will now write and say that we should insist you *all* fit guards! They are well-meaning souls but while you can take a horse to the water you cannot force it to drink. The advice, then, must be to keep well clear of revolving parts and sharp tools at all times.

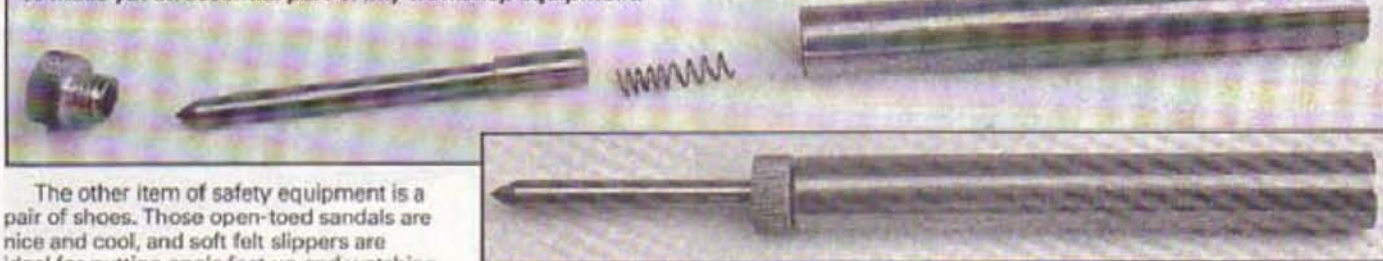
Any ladies wishing to indulge, should tie up those lovely long tresses. Chucks seem to act as magnets for them and, once caught in the revolving chuck, it becomes hard to get at the switch. That means that the planned romantic night out must take place with a lopsided head as all the hair on one side has had to be cut off to release the owner!



Work and tool holder

Having rightly established the safety aspect, even if only to a limited degree, let us now think about the masterpiece we are about to turn out. If indeed it is a masterpiece we intend to turn out, then there are certain essentials that we need to do. Firstly, the work must be held securely in the chuck. This involves tightening the chuck on the work as hard as possible by hand. It is, of course, possible to tighten it even more, by hitting the chuck key handle with a hammer, or climbing on the bench and treading on it. It is also possible to put

The parts for the centre finder body. The end cap has been knurled with a cigarette lighter wheel. The hole in it must be a good sliding fit for the point. The spring came from a ball-point pen but any similar spring will do. Below, the finished item; simple to make yet an essential part of any workshop equipment.

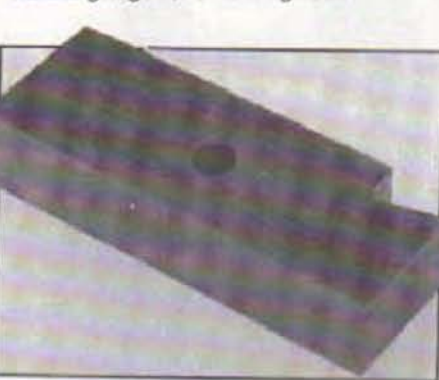


The other item of safety equipment is a pair of shoes. Those open-toed sandals are nice and cool, and soft felt slippers are ideal for putting one's feet up and watching television. If anything sharp falls off the bench, however, it invariably lands point down, even if in theory it should not, and of course the falling object, like us, has a sense of self-preservation and falls not on the hard floor but instead will look for some nice soft toes to break its fall. The larger the lathe, the larger the work possibly being carried out and the heavier the clump on the foot. Shoes offer some protection against this.

In theory, we should wear heavy overalls, headgear, goggles, and hobnailed boots. The hobby is for fun, and very few will want to dress up like that and frighten the neighbours, so just a little commonsense will suffice in the home workshop...

Keep clear of revolving machinery. Even the little compact lathes will give a nasty gash if they catch the hand or arm. All revolving parts *should* be protected by guards, but we all know that this does not

Back to the centre height gauge; this is the base with the hole drilled. One edge has been machined (or could be filed) to an angle to match the average tool and so provide a gauge. A piece has been removed from one corner to provide a similar gauge for a turning tool.



a piece of tubing over it and extend the length by a couple of hundred percent. All these ruses are unnecessary. The manufacturers know just how much pressure is needed to get the chuck tight and chuck keys are made to that specification. As hard as possible by hand using the existing equipment is fine. Any more and extra stresses are put on the chuck.

The lathe tool must also be held tightly in the tool post, the same rules generally applying for tightening as with the chuck. We need to do a few other things though and these are important. The tool must be correctly ground. It has three angles and these should be about right. Again, the purists will be shouting that they must be *exactly* right. The difficulty is that we need different angles for each type of material, including several for different types of steel. We also need different angles for different finishes. This will involve having large

quantities of lathe tools and frequent changing of them. There is no doubt that this is the correct thing to do and readers should be advised to have the correct angle every time.

In practice, in the home workshop it is almost impossible to go about things in this way and most readers will probably just have a couple of tools. These should be ground to the best general angle for the work to be done. So in theory this is not correct. In another article we talk about carbide tools, and if we buy ready-made tools of this type then we use them at the angles they are supplied in as a rule, and for whatever material is being machined. Our tools, therefore, must conform to the general design but need not be perfect.

After grinding to shape, tools should be lightly honed over with a fine carborundum stone that is well oiled; this just takes the rough burrs off and helps give a nice finish.

One thing is absolutely important and that is the height at which the tool is set. We can get away with all sorts of bad practice if we can achieve the correct height setting. Not that we should try and get away with bad practice; we mention this just to point out the importance of correct setting.

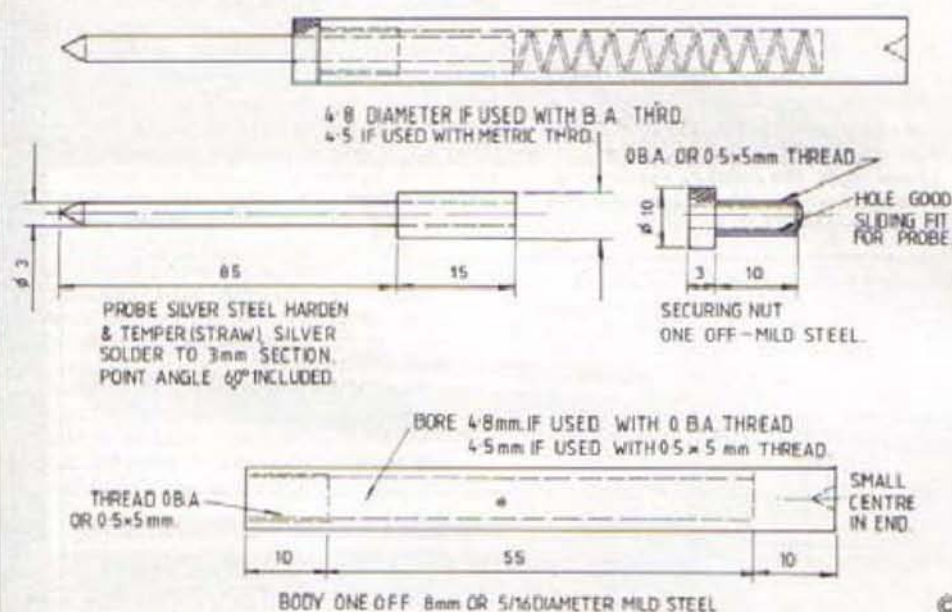
Wobblers and wigglers

Of course there is a snag, but then there always is! What is it this time? Well, in order to get the centre punch mark running true we need a tool called a 'wobbler', or 'wiggler' – or by other names when it cannot be found! This is a simple little thing

and is the answer to our starting problems as making the wobbler is going to be, whether we like it or not, the first major bit of toolmaking. Not to worry, the combination of drawings and photographs should show how it is done, and once we have it, it can be used for all sorts of things.



CENTRE FINDER



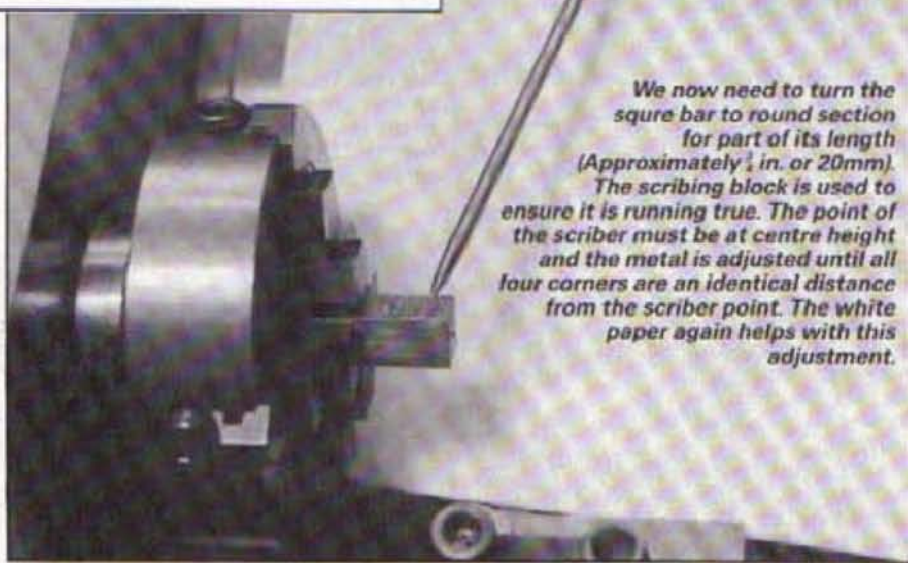
The actual gauge bar is made from a piece of $\frac{1}{2}$ in. (10mm) square mild steel (about $1\frac{1}{2}$ in. long). Mark the hole position and set it to run true as with the base. Centre drill as before.

The measurements shown on the drawings are suitable for a compact lathe. For larger lathes, double everything, and for really large lathes, treble everything. If you do not have the material specified, not to worry, as sizes are not important – so long as the hole that the point slides in is accurate, it can be made to any size you want and will still work.

Height gauge

The tool height can be set in relation to the tailstock centre which is a workable but somewhat cumbersome method. It's far better to make our first job the manufacture of a height gauge. There is nothing tricky about it, it is simply a post with a bar on it. The post is set in a base, and the bar is set at centre height and locked in position at the correct centre height of the lathe. It remains thus for as long as we need it. Thin metal shims can be used to pack the tool to centre height, but we will be giving details of various tool posts to make this easy in later issues.

The hole in the base of our height gauge must be perfectly square, and it is best not to rely on a drilling machine for this, but rather to put it in the four-jaw chuck of the lathe and drill it from the tailstock. This is always a far more accurate method of drilling.



We now need to turn the square bar to round section for part of its length (Approximately $\frac{1}{2}$ in. or 20mm). The scribing block is used to ensure it is running true. The point of the scriber must be at centre height and the metal is adjusted until all four corners are an identical distance from the scriber point. The white paper again helps with this adjustment.

Back to the height gauge

Once we have the wobbler, and can set the base of the height gauge accurately in the lathe for drilling, we can set about finishing the gauge off. It is a good idea to put an angle on one edge of the gauge to match the angle of our most-used turning tool. This enables the tool to be ground accurately, as it can be checked against the slope on the base. Likewise, a piece cut out at the end can act as a guide to the front angle of our tools. To put on these angles the work can be mounted on the worktable and milled with the milling attachment set



over, if one is available. Failing that, they can be carefully filed out, this not being at all a difficult task.

The central pillar is simply a piece of round bar of suitable length that is a good fit in the hole drilled in the base. It can be held in position with a grub screw via a hole drilled and tapped in the base. The arm that acts as the setting guide can be made in a variety of ways; possibly the easiest is to take a short length of square bar and drill in it a suitable size hole that will slip over the pillar. Turn it round in the four-jaw chuck and machine it to a diameter of about $\frac{1}{8}$ in. or 5mm to a length that will allow it to overlap the base. Remove it from the chuck and drill and tap the end for a grub screw. File either a flat or an angle on the end where it will act as a gauge for the tool in the tool post. The tool can now be set absolutely accurately to centre height.

Starting work

Having become major toolmakers with the construction of a wobbler and a height gauge we can now start on some basic turning! Unfortunately, we cannot in this issue go into the details of rotational speeds of metal, but adopt these general rules. The larger the diameter of material, the slower it should rotate. Steel should rotate slower than brass or aluminium, as a rule, and cast iron generally rotates slowest of all. As the lathe will probably only have about six speeds, it will not take a lot of working out that a small diameter piece of brass can be machined at the fastest speed while a piece of cast iron which stretches the chuck to its limit needs the slowest speed. Generally, if the machine is at a good speed for the material then turning will feel right. If not, then it will just plainly feel all wrong.

Depth of cut

The depth of cut is the depth to which the tool is pushed into the metal. A little commonsense is all that is needed. Start by taking tiny cuts, and, as you practice, take deeper ones. At the first protest from the

lathe – and they can protest quite loudly – things have gone too far and it is time to go a little less deep. Again, it is possible to take deeper cuts on brass than on steel or cast iron and so each material must be treated on its merits.

Feed

The feed is the speed at which the tool is traversed along the rotating metal and must be consistent to get a good finish. Those who have an automatic feed can set that to the finest feed and use it. If no feed arrangement is fitted then traverse the tool

Left, make a small centre mark in the end of the square bar and use the hard centre to support it while it is turned to the required diameter. The actual diameter is not important and so an exercise such as this is useful for the beginner. Set yourself a size and machine to it. Try to get the diameter as accurate as possible, then ask yourself if you are satisfied with the finish. If not have another go setting yourself another diameter to work to. Aim to get both diameter and finish as near right as possible.

Below, when the diameter is completed the work is turned round in the chuck and drilled and tapped for a grub screw. (About 4 BA or so is about right.) Instructions for drilling are as on previous parts of the height gauge. Tapping is done using a tap wrench supported by the tailstock centre. Release the lathe belt and wind the chuck round slowly by hand. The tool post prevents the tap wrench turning. Keep releasing the tap to ensure it does not stick.

Finally, file a small flat on the round section and the edge of it to a slight angle. The gauge can then be assembled (bottom photo).



as slowly and evenly as possible. Do not think that because there is no automatic feed a good finish cannot be obtained. Some centre lathe turners actually prefer to hand-feed, as they can feel for themselves the finish they are getting.

Holding the work

Finally, always try and hold the metal by its largest diameter when turning. Rigidity is important and a piece of metal, say with a step $\frac{1}{2}$ in. diameter but being 1 in. diameter on its circumference, will not be very rigid if held by the small diameter. The resulting finish will be poor.

We could go on about basic lathe skills all through this issue and still hardly touch the subject. There must be a limit however and so we will leave it with this briefest of descriptions to develop the theories in later issues. Remember, however, the important things: **TOOL AT EXACTLY CENTRE HEIGHT.** Set rotational speed lower rather than faster than required. Do not take too deep a cut. Feed slowly, and hold the metal as rigidly as possible. **SPARE A THOUGHT FOR SAFETY – ALWAYS.**



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SWING-CLEAR REAR TOOL POST

A rear tool post is a valuable asset when parting-off but they can get in the way when making adjustments and limit the diameter of material to be machined. Ours solves the problem by swinging clear when not in use. Pull-out drawings in the centre of this issue.

One of the most useful accessories that can be made for a lathe is a rear tool post. Because the thrust on the tool is against the lower part of the



The extension seen from the top; the two holes for the Tee bar must be square across the metal. The curved recess follows no set size and is a matter of choice.

headstock which is supported on the bed there is a greater rigidity which makes parting off that much easier. The rear tool post can also be used to advantage with a boring bar, as it frequently allows a better view of the cut than a tool held in the conventional post. But, of course, it has other uses as well and is of exceptional value when using form tools. One problem with fitting a rear tool post is the fact that, unless one has a long cross slide, there is usually insufficient room. This design takes care of that as well as providing an exceptionally rigid tool support.

The basic design of this tool post came from Henry Hartly of Grimsby who has used one with success for many years. His tool post forms the basis of the one about to be described, but some slight variations have been made which we hope will make it more easily adaptable to different types of lathe and give added support, particularly as some modern imported lathes are a little weaker on the cross slide casting than older British models.

It has several advantages over the normal type of rear tool post. Even with an extended cross slide there is rarely a great deal of room to get between the normal tool post and the rear one without knocking against one or the other. This design allows the actual post to be moved back out of the way when it is not required, which means that it can remain on the lathe during most operations. It also means that two or three tool posts can be made and interchanged very easily.

For lathes without an extended cross slide, a rear tool post with an extension is the usual method of dealing with things. This design also has an extension which is considerably longer than the normal type, and so has been made of thicker material to make it more rigid. To allow movement over the bolting section it has been thinned at

this point. Frequently, rear posts with extensions are made to cover two tee slots to allow extra bolting capacity and to avoid the very real danger of tearing the tee slot from the casting if support is only provided on one. Covering two tee slots reduces the already limited swing over the top slide and can make life quite difficult. An extra support below the extension allows the tool post to be used on one tee slot only, giving extra swing capacity.

Finally, because of the method of construction the tool post itself has two slots as against the more normal single one. The result is that two different widths of parting tool can be kept in place, or alternatively an extra turning or boring tool can be housed. It is also possible to make up a number of posts to accommodate various tools and to interchange them easily. Doing this allows tools to be set at exact centre height and remain there without the need to continually make adjustments.

The extension

Construction of the tool is quite straightforward. The extension is made



At left, the single point cutter described in the text and shown in the sketch overleaf; it was used to cut the slot in the extension. In the large picture we see the Tee nut (on right) which accepts cap screws to hold the extension to the cross-slide. In the centre is the supporting screw for the extension which threads through the bar below it. Note that, in this case, a knurled section has been fitted to the screw as a means of adjustment; an ordinary nut could be used or a lock-nut fitted each side.

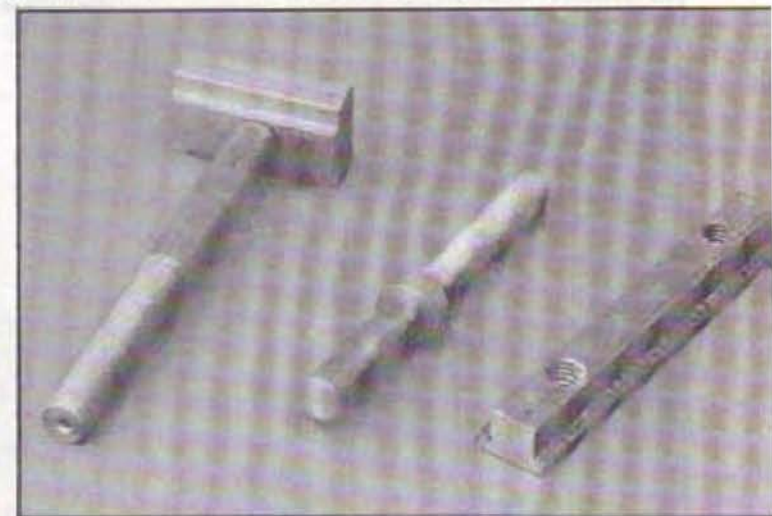


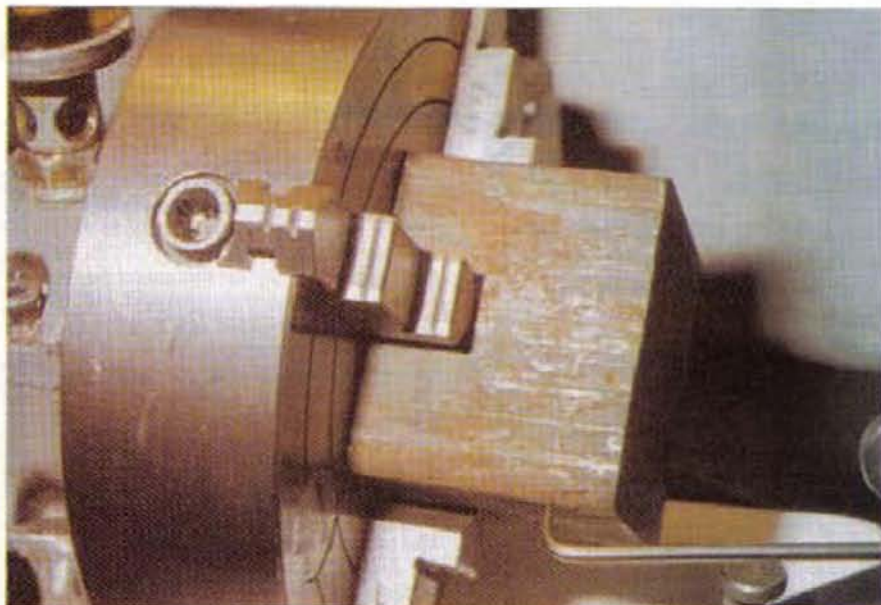
The extension from below; this view shows the bar in which the supporting bars will thread.

from mild steel bar and the sizes shown on the drawing suit the Myford range of lathes; alterations to the sizes can be made to suit various lathes. It is essential, however, that the extension is at least two thirds the width of the top slide in order to provide the necessary support. If mild steel is not available then a cast-iron section would work just as well. It is understood that College Engineering Supplies will stock the required material for the tool as well as the cast-iron block for the actual posts. If mild steel is used then ideally it should be fly-cut to ensure that it is flat at the base, unless ground mild steel can be obtained. There is no reason why black mild steel should not be used as long as the surface is suitably dealt with as above.

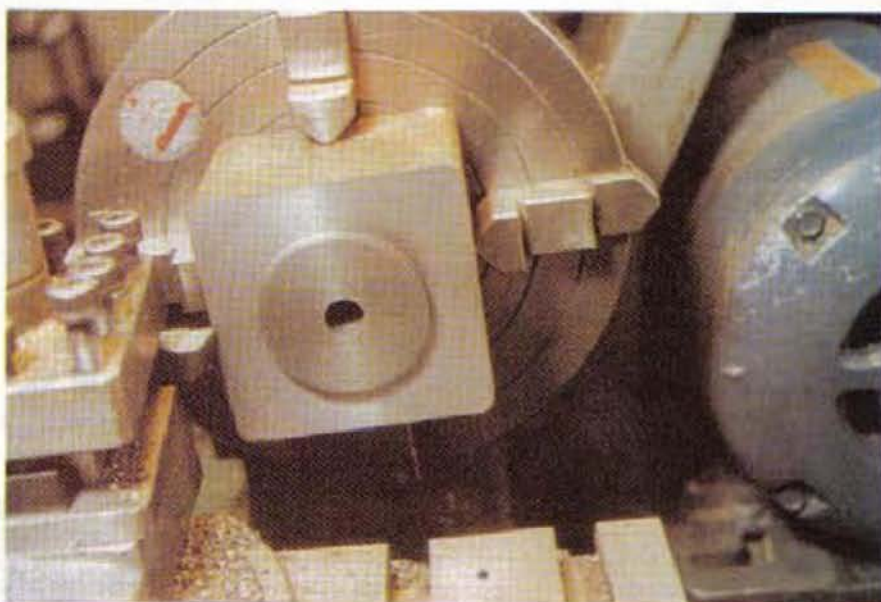
The holes for bolting the extension should be drilled first. They must be carefully marked out and centre drilled. It is essential that the holes are square across the metal, and it is better not to rely on eye for this purpose but to use a machine to ensure that it is accurate. If a milling machine is available this is comparatively straightforward. The block can either be mounted in the machine vice or bolted to the table and the centre drill placed in the mandrel and wound across the work. If only a lathe is available, it is hardly more difficult. Simply mount an angle plate on

the cross slide, bolt the metal to it and use the centre drill in the chuck, again winding the cross slide over to ensure that both holes are exactly in line. It is not necessary

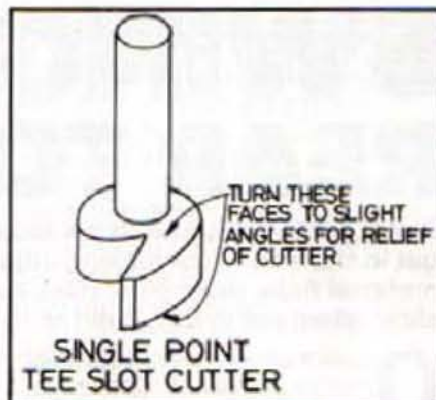
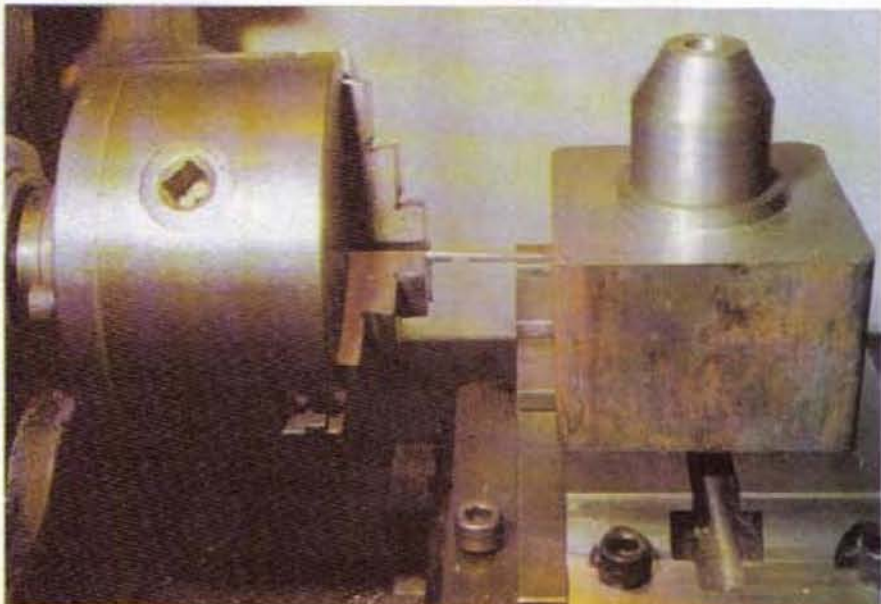




The tool post itself is a simple boring exercise but it makes a neater job if a boss is turned on the top. To do this, the work is set in the four-jaw chuck using a scribing block to ensure true-running.



Above, hole for the securing bolt has been drilled and the boss is being finished off. Below, the scriber is used to mark a line for milling the tool slots.



to drill the holes with the metal in the lathe or milling machine, it can be removed and the drilling carried out on the drilling machine. At this stage, drill the holes with the tapping sized drill, as this will ensure accuracy when the tee bar is drilled. The holes can be opened out to clearance later on. The holes should be counterbored using a slot drill if a counterbore of suitable size is not available. When the metal is machined, these counterbores become recesses for the cap screws as half the counterbore will be machined away. An alternative therefore, is to leave the counterboring and, after machining, run a slot drill in sideways.

The reduced section should be machined first of all. It will be seen that a radius is shown; this provides a certain amount of extra strength to the finished job. It may be difficult to do if a ballnosed cutter is not available but, if this is the case, use a fly cutter with a rounded tool. Progress down and outwards and a suitable radius can be obtained which can be cleaned up afterwards with a file. That is the way the one shown in the photographs was done.

The Tee slot

The Tee slot is formed in two simple operations, again using the cross slide and an angle plate if no milling machine is available. The vertical slide could be used, but readers will probably find the component can be mounted more rigidly against an angle plate. Start with a slot drill and mill the slot using the correct size cutter if possible. If one is not available it can be done in two runs. Whatever the method, it must be a good fit for the size of bolt that will pass through it. The tee is cut as a rule with a proper tee slot cutter. If one is not available, do not despair!

Tee slot cutters

Take a piece of silver steel of the required diameter, and turn a shank on it which will just clear the slot. Mark off three evenly spaced sections. File out the cutting edge and harden and temper to a light straw, honing up the edges afterwards with a small stone or diamond lap. Of course, we only have a simple single-point cutter but it will cut the slot as well as a tee slot cutter providing it is taken a lot more slowly than one would expect to work with a multitooth cutter. Those with some experience can make the cutter with six cutting edges – it is simply a case of careful marking-out and filing or machining. At a later date we hope to offer a complete article on the subject. Silver steel cutters are reasonably cheap to make, but will not have a very long life. On the other hand, tee slot cutters are



The Tee nuts

We now need two Tee nuts, a double length one to hold the device to the cross slide, and one to hold down the tool post. The Tee bar which secures it to the lathe gives a better spread of the forces on the cross slide. The one holding down the tool post can also be made slightly longer than normal to good advantage. When these have been made, mount the extension on the cross slide centrally rather than in the position in which it will be used, and check it is square. Mount the tool post on the extension, again ensuring squareness and bolt it down hard. Either mark it with a scriber held in the lathe chuck to be machined on the milling machine, or with a milling cutter held in the lathe, mill the slot for the parting tool. Turn the post round and mill the other one.

The handle

The stud which holds down the tool post is silver soldered to the Tee nut which, of course, means it now becomes a Tee bolt. The bolting down can be done with a spanner on an ordinary nut if one so wishes. Alternatively, a handle similar to the one shown can be made up.

The tool will prove its value to the constructor in no time at all. It can conveniently be left on the lathe at all times. However, the extension does have other uses, as it provides a very useful base on which to mount a dial test indicator or tool height gauge, and neither of these functions requires the complete removal of the tool post.



expensive and are only likely to be used two or three times, so making one's own cutter is well worth considering.

It only remains at this stage to ensure that the top of the component is still flat after the machining operations have been carried out. Check this with a steel rule and if there is any discrepancy, go lightly over it with a fly-cutter.

Strengthening bar

Because the extension will only be bolted on one tee slot it is necessary to add strength in several ways. The first of these is by bolting it to a bar of metal underneath with two tapped holes which will take supports to butt up against the cross slide. The bar is made from mild steel square section, and drilled tapping size at first for both pairs of holes. Again, accuracy is essential and the holes should be started with a centre drill using the machine in the manner already described. Two cross holes in the bar accept studs with a captive nut and a locknut to butt up against the cross slide to give extra support and add rigidity. The position of these holes must be such that there will be room to fit the locknut, and the size of this will depend on the chosen thread.

The tool post

The tool post can be made of steel or cast iron. It should be faced on all sides and top and bottom to ensure it is square – this can be done in a four-jaw chuck or on a milling machine. The hole should then be bored for the locating bolt.



At left, a view of the other side of the finished tool post showing the spare slot for another tool, which is optional. In this illustration (right), the tool post has been brought forward ready for parting off. Readers who want an even quicker method might consider putting a small stop across the extension with which to line up the post when it is positioned.

SMALL KNURLING TOOL

There are many times when it is desirable to knurl work, either as an aid to providing a grip or for purely cosmetic reasons. Much has been written about knurling over the years and many designs have been published for tools. We will be giving readers such designs in future issues, since what suits one does not necessarily suit others. The little tool described here is easy to make and has the advantage that it will fit the small compact type of lathe as well as large models.



There has been a great deal written about knurling over the years, the quality of the finished product, as well as the method of achieving the pattern. We are sure that most readers who wish to knurl work are content to have a reasonably knurled finish without going into such things as pure diamonds on the pattern, etc. This little tool will give that reasonable knurl, but, more important, it is easy to make. It has a big advantage over many designs. There is always a tendency for the tool to pull sideways when used which can create a certain amount of whip and even with a two wheel type of tool cause both a strain on the lathe and a bad finish. This design prevents most of that sideways movement.

The sizes shown in the drawings of the tool are about right for the normal small lathe and for knurling wheels of $\frac{1}{2}$ in. diameter or so. If different sized wheels are used, some alteration may be required to the ends of the arms where the knurling wheels are held. At the same time, this size of tool will work very well in lathes of about

3 $\frac{1}{2}$ in. centre height with just an adjustment to the position of the holding bar.

The side plates

It is as well to start with the side plates as they form the main strength of the tool. It would be quite easy but very wrong to use a thin gauge material for them because of this. They are made from two $1\frac{1}{2}$ in. lengths of $1\frac{1}{2}$ by $\frac{1}{4}$ in. mild steel or the metric equivalent thereof. Simply cut and file them to shape. Mark out and centre punch for the two pivot holes on one piece. Clamp the pieces together and drill them as one piece, drilling both to the tapping size that will be required for the pivots. The clearance side can be opened out when the work is due for assembly. Do not at this stage drill the holes for the clamping bar.

The arms

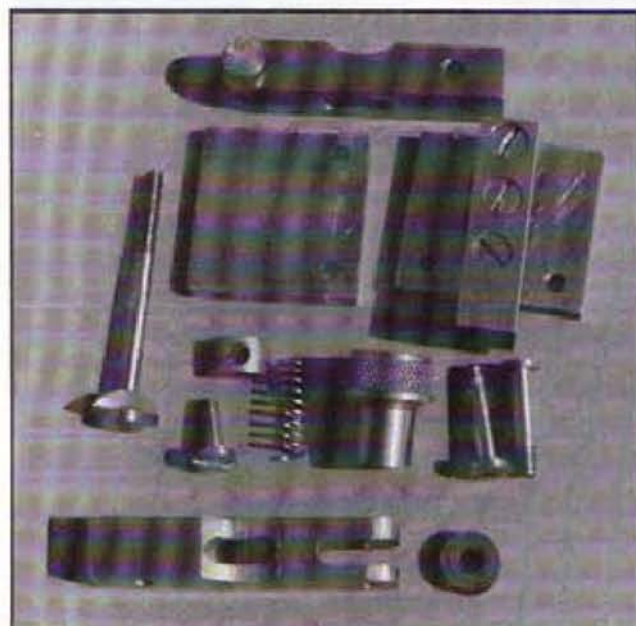
These are pieces of $\frac{1}{2}$ in. square mild steel bar cut to length and marked out individually. The pivot holes can be drilled and then the holes which will take the

The finished tool mounted in the tool post; it is versatile enough to be used in a small compact type of lathe as well as in larger models.

spindles for the knurling wheel can be drilled tapping size, opened out clearance size half-way through the bar and tapped for the rest of the bar thickness to take the spindle. Before doing this, readers must make their minds up on two things: Firstly, what the diameter of the hole in the chosen knurling wheels will be; secondly, how they will be fitted. Because the wheels are very hard, a mild steel spindle will wear away in a matter of minutes. The spindles will either have to be made of silver steel and hardened or small bushes of bronze slipped into the knurling wheels. If this is done, then obviously the spindles will be of a smaller diameter, and the holes in the arms correspondingly so. Use a half round file and file out the recesses with both arms held in the vice together.

The pivots and spindles

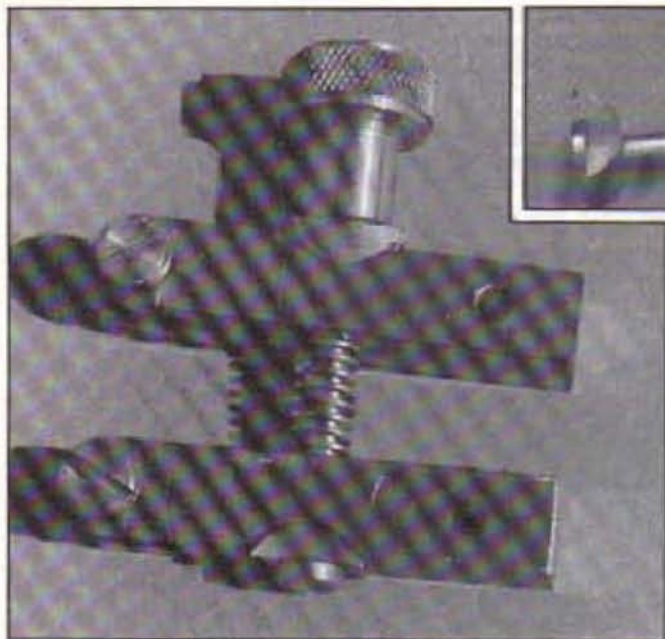
This is ordinary simple turning work. The pivot pins can safely be of mild steel but the spindles, as already pointed out, will depend on the method chosen as to whether mild or silver steel is used. The heads of both spindles and pivots have



The parts of the tool. Construction is by no means difficult, nothing more than straight-forward turning, drilling and filing being required to produce a first-class tool.

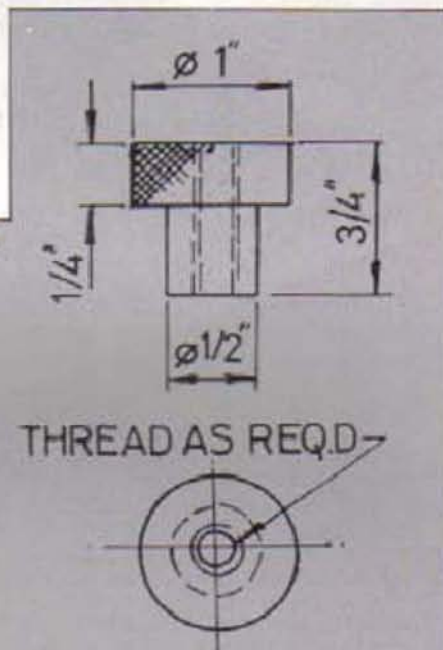
The side plates and arms of the small knurling tool. The half-round sections can be filed to shape.



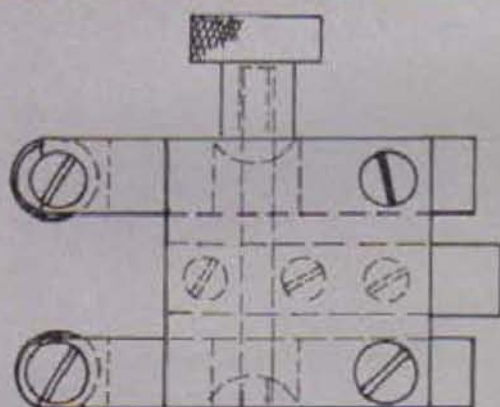


The clamping screw and half-round pieces.

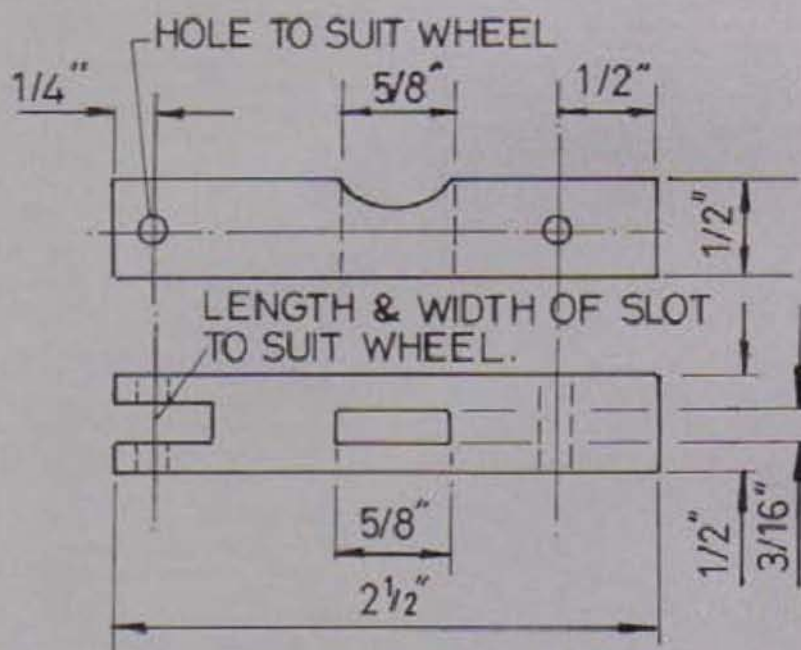
The arms and the clamping/adjusting screw showing the method of construction.



KNOB 1off MILD STEEL



KNURLING TOOL

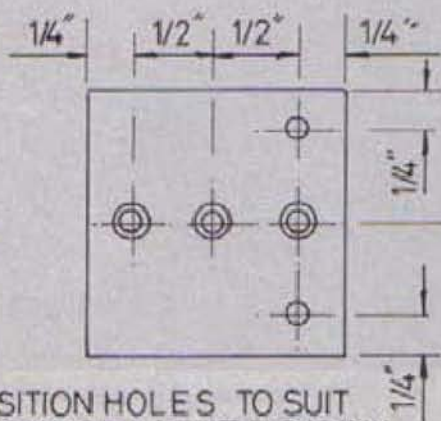


ARMS 2off MILD STEEL

slots cut in them with a hacksaw to allow them to be tightened up with a screwdriver. The alternative would be to use hexagon material, leaving thin hexagon heads for tightening up.

The clamp

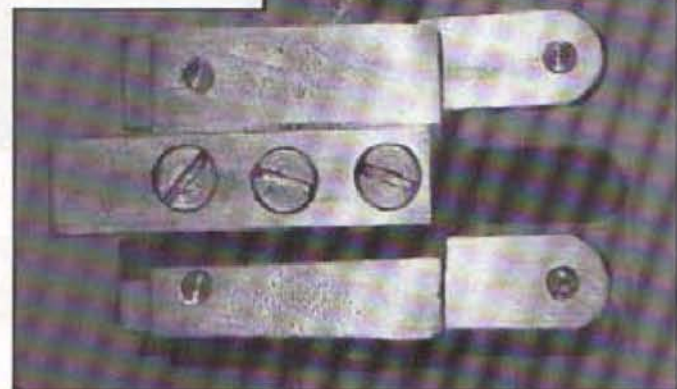
This is in four parts plus, of course, the spring. The actual screwed rod can either be turned to size leaving a lip on one end and threading the other, or can be a plain threaded rod. The tightening knob, which is a straightforward drilling, tapping and turning job, can be made later as it needs the tool itself to knurl it. The two half-round pieces are simply a short length of bar drilled clearance size for the thread on the tightening screw crossways, and then sawn in half across the other ninety degree angle. Any suitably sized spring will do, as long as it has sufficient power to open the arms as tension is released.



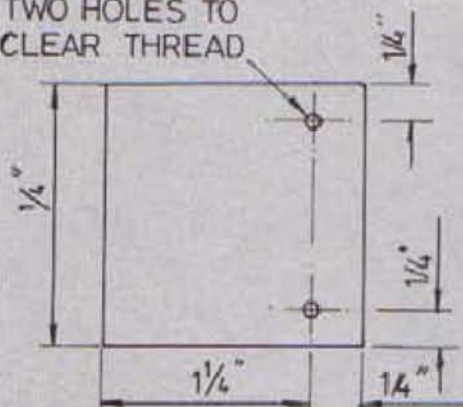
POSITION HOLES TO SUIT
HEIGHT OF LATHE & C/SINK
TO SUIT SCREWS.

RIGHT HAND SIDE PLATE
3/16 MILD STEEL PLATE.

The finished tool
shown from the tool
post side; note that,
although the screws
are fitted in this case
from the the outside,
they can be fitted as
easily the other way
round.

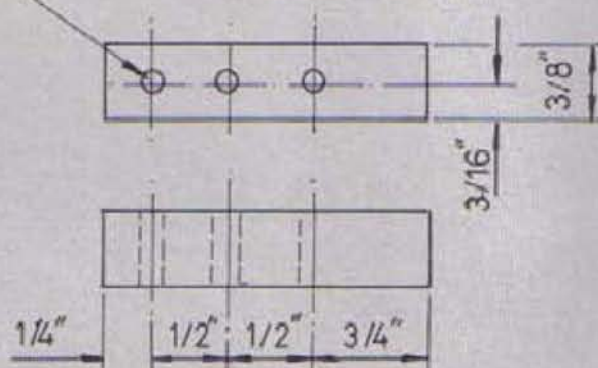


TWO HOLES TO
CLEAR THREAD



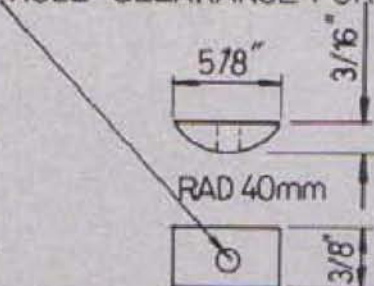
LEFT HAND SIDE PLATE
3/16" MILD STEEL SHEET

3 HOLES TAPPED 2 B A OR TO SUIT
CHOSEN SCREWS



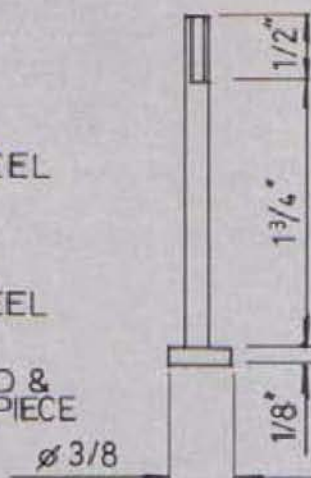
TOOL POST CLAMP BAR 1off M.S.

HOLE-CLEARANCE FOR ADJUSTING SCREW.



SWIVEL PIECES 2off MILD STEEL

ADJUSTING SCREW 1off MILD STEEL
THREAD TO SUIT KNOB
ALTERNATIVE TO BOSS, THREAD &
FIT TO HALF ROUND SWIVEL PIECE
& SECURE WITH LOCTITE 601.



The holding bar

This is a piece of square mild steel bar and its position on the tool will depend on the size of lathe on which it is to be used. The best way to sort this out is to assemble the parts made so far using a nut on top of the clamping screw until the knob is made. Put a short length of rod in the lathe chuck, and a hard centre in the tailstock. Wind the tailstock out nearly to its fullest extent. Tighten the knurls on the bar in the chuck and get the part-finished tool level, if need be by supporting it on pieces of packing. Bring the hard centre up against it and a tiny mark will be left. Take the thing apart and, with a square and using the mark as a guide, mark off and drill the holes for the holding bar, tapping size. Clamp the holding bar to that plate and drill through. Tap the holding bar and open out the side plate holes to clearance size. Countersink the holes for the screws. Note that the tool shown in the photographs has the screws through the bar into the plate, but putting them through the plate to screw into the bar is the best way of doing it.

It just remains to make the knob and clean the tool up. It does not cost a lot to make, is also very easy and will pay for itself many times over.



HIGH TEMPERATURE SOLDERING

In the last issue we dealt with soft soldering, the best way of going about it, the materials to use and the uses to which it can be put. We now go to higher temperature soldering or brazing principles, and try to offer readers advice and help on a subject which, to many, would appear to be something of a mystery. Some readers in our readers' questionnaire in the last issue requested an article on complete boiler-making. This we can do at a later date but it will take time to prepare in order to produce such an article to the high standard we would wish. So, for the moment, let us first look at the basic principles of high temperature soldering; only if we know these can we even contemplate making a boiler!

The stronger we need the joints in our metal to be, the higher the temperature at which the work needs to be done. Well, that is roughly the idea, but, of course, there are many variations on the theme. The subject of soft solders has already been dealt with at length (MEW Summer '90) and now we are going to talk about the harder types of solder. Such soldering is usually referred to as 'brazing', even though silver solders are used. If we simplify matters to the utmost, we have two types of solder - those containing silver and those with spelter which is more or less a brass rod. This is an oversimplification, as there is a wide range of silver solders and several different forms of spelter which are made to differing formulas.

All these metals will have one thing in common so far as the modeller is concerned. They cannot possibly be used with a conventional soldering iron, and heat must be applied by means of a blowlamp or torch of some form or another. They also require different fluxes to those used with the soft solders. As with fluxes for the lower temperature solder, some can be obtained in paste form, and some silver solders can be obtained as thin sheet, or shim, as well as in little rings and other shapes for special applications. These forms of silver solder are not generally stocked by model engineers' suppliers as they are for specialist applications. The sheet, in particular, is useful for making jewellery and is stocked by some craft suppliers.

Let us start by discussing the equipment needed to make a joint with silver solder, as this will be the most important thing. There are, as we shall see, some silver solders which melt at a comparatively low temperature but normally we will be using those with a range of six hundred to eight hundred and fifty degrees Centigrade. That is very hot. As with soft solders, silver solder must dissolve on the metal to which it is applied rather than by the heat of the torch. This means that if we are heating the metal and put the silver solder into the

flame it will melt very rapidly. A piece will come off the stick and will form a globule which will remain as that on the work, the work itself not being hot enough to melt it.

Silver solder, like other solders, has two melting points, called the 'solidus' and 'liquidus'. When our globule forms, what has happened is that the solder has reached the solidus temperature and part of its content has melted. The liquidus temperature has not been reached and so that globule remains solid. We now need to get that piece of material to a much higher temperature for it to melt completely; it no longer has the solidus content to combine with and so extra heat will have to be applied in order to melt it. It will be better to remove the globule and start again, this time making sure that the solder is melted by the heat of the metal and not the torch.

To some extent, the above paragraph has pushed a little further ahead than we need at this point but it illustrates an important point that will be a basic principle of the work to be carried out, which is that we need to heat the metal to the required temperature. Suppose then we are to use a solder that will melt at six hundred and fifty degrees centigrade. We start by fluxing the metal and then apply the torch until the metal reaches the required temperature. That sounds reasonable enough, but is not quite as straightforward as that. The little torch shown in the last issue for soft solder about the size of a pen will, for example, give a temperature of about twelve hundred degrees at the point of the flame, so why should we not apply that to the metal and heat it up? That will work surely. The answer is no. We not only need the temperature but we also need a volume of heat. Our parent metal is going to disperse the heat at a fairly rapid rate - it will depend on the type of metal as to what this rate is. Steel will not, for example, disperse heat as quickly as copper. With a small torch, even though the required temperature is there, the volume of heat is not sufficient to correct this loss. Our small



Portable gas cylinders should always be fitted with a hose failure valve such as this. In the event of a hose leak or other mishap, the valve automatically switches the gas off.

torch will probably heat a piece of silver wire to the correct temperature for jewellery-making but will not make any impression on a sheet of steel. Our first principle must be to ensure that the torch not only gives a high enough temperature but also that it has the quantity and speed of heat we need.

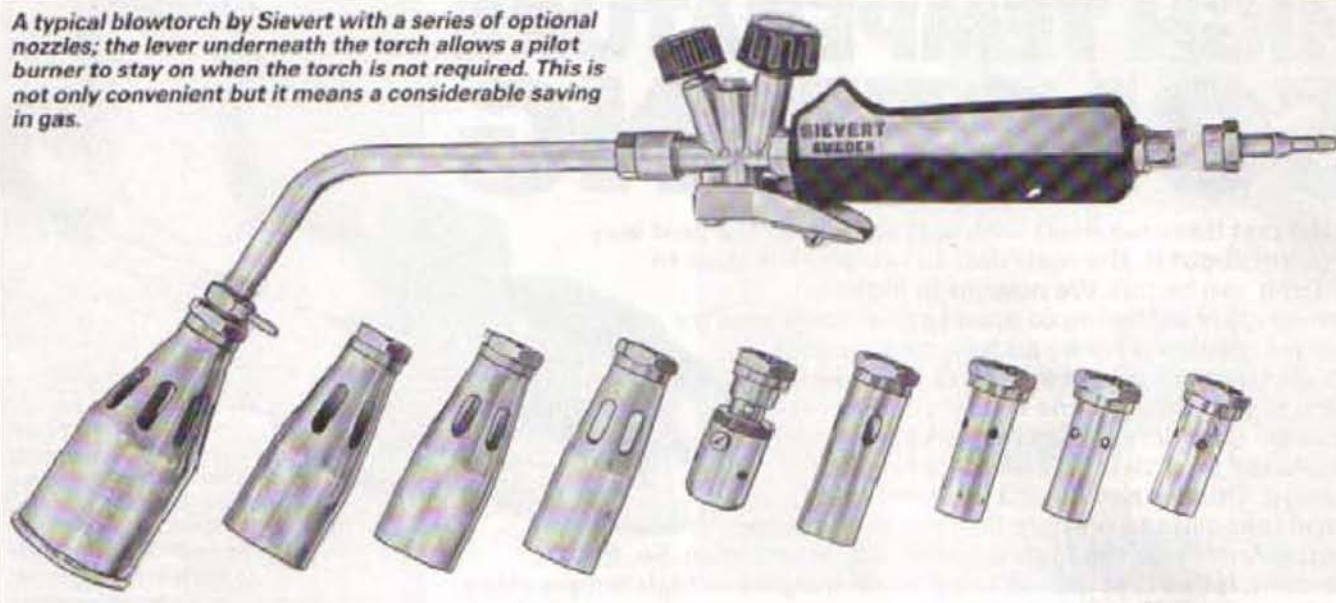
Torches

There are many types of blowtorch available and various gases with which they can be used. The ordinary DIY blowtorch is not suitable for brazing in general. It will certainly heat small pieces of metal to suitable temperatures but the heat will be so spread about that the work will be messy. Still, any port in a storm, and if that is all you have then go ahead and use it. For more general work a torch will be required that will give a flame that is not too widespread. This in itself must be relative, as the larger the area of work the greater the spread of flame will be, but we want to concentrate that volume of heat as far as practical on the place it is needed rather than spread it all over the place. The torch can operate either on butane or

This valve cuts out automatically and will also allow the pressure from the cylinder to be varied. This has advantages when doing large area work such as boiler-making.



A typical blowtorch by Sievert with a series of optional nozzles; the lever underneath the torch allows a pilot burner to stay on when the torch is not required. This is not only convenient but it means a considerable saving in gas.



propane gas. Butane has the disadvantage that the cylinder rapidly goes cold as the torch is used and there is even a risk of a freeze up in very cold weather. Propane is the ideal answer to a single gas for model engineering purposes. This does not mean that butane cannot be used and if suitable equipment is to hand then go ahead and use it. Also, we must not forget our ordinary domestic gas supply; whilst lacking the general heat of propane, with suitable equipment it is good enough for most model engineering purposes.

It is possible to buy outfits which operate on propane and oxygen or acetylene and oxygen; these are expensive but very good. The oxygen is burnt off with the other gas giving a good volume of heat in a very small area. This allows the joint to be kept neat and tidy but we are still faced with the problem of heat loss from the metal and so the thicker the metal to be worked on, the larger the nozzle we will need to use. With large areas of copper such as a boiler, the loss of heat can be too great even for a small oxygen-assisted torch. To some readers the expense of buying such equipment may be prohibitive when compared to the use it will get. In this case it can be hired at a reasonable price and if a lot of silver soldering is to be carried out over, say, one weekend it is worthwhile thinking about hiring a set. For most people a propane torch will be sufficient and different sized nozzles can be added as required. For general work such as silver soldering crankshafts, tools to shafts, and carbide tips, a propane torch is adequate. A large sized torch of this type will also do when making boilers.

The working area

Once we have the means to silver solder we come to the question of where to do the work. It should not be done in the general workshop area. The heat will cause condensation no matter how well insulated the workshop, and this will cause rust. The fumes are also inclined to cause oxidation on metal so, again, the work must be kept away from tools. In the fine weather there is no reason why general brazing work should not be carried out in the open. There will be some loss of heat but the propane torch in general will take care of this. The alternative is to use a garage once

the car has been removed and assuming it does not double as the workshop. If all else fails and the workshop area must be used then give everything a good spray with WD40 before starting and if possible cover the tools with sheets of newspaper to absorb the moisture. Take care though that the heat does not cause the paper to catch fire.

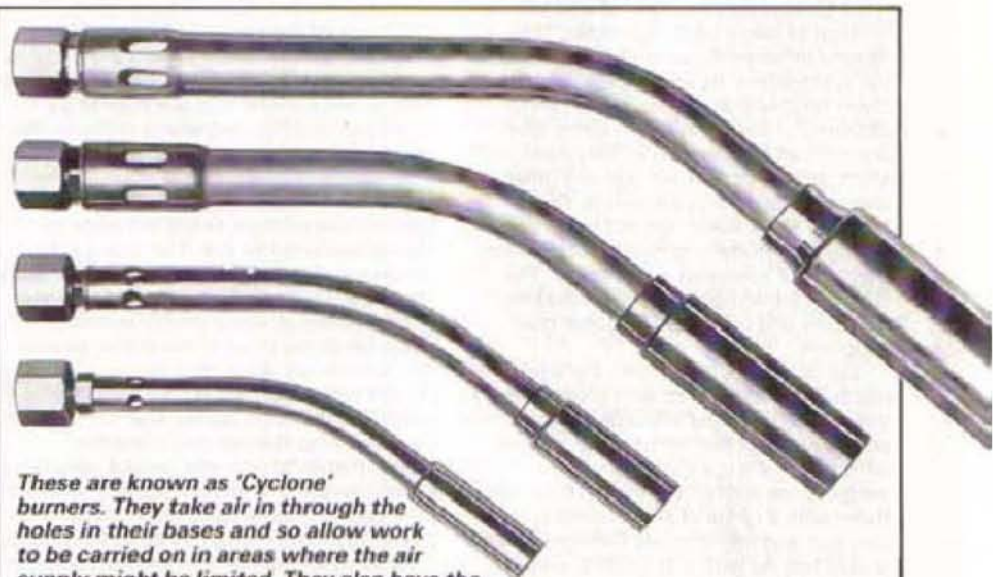
The brazing bench

The work itself should be carried out on fire bricks. Bricks of the refractory type are best as they reflect heat back to the work and give a quicker heating-up time, conservation of heat being vital. If only a little amount of work is to be carried out on an irregular basis an ordinary housebrick will work, but a firebrick will be better. If the intention is that a great deal will be done over a period then make up a brazing hearth with a metal tray full of firebrick; in the end it will pay dividends. A useful alternative to brick is a small steel tray folded from sheet and filled with ceramic chippings. These are used by jewellers and can be purchased at good craft suppliers. They reflect the heat very well and the

work can be nestled into them and will support itself in position.

The soldering operation

Work to be silver soldered or brazed must be clean; it should be supported in the position in which it is required either by some form of jig or clamp. Unlike for soft soldering, wooden jigs cannot be used, and care must be taken that, if a metal jig is made, the area to be soldered is not in contact with the metal of the jig, or the whole lot will be soldered together. Getting them apart can be difficult and messy. The sections to be joined should not be pulled hard together, but a tiny gap of a couple of thousandths of an inch left for the capillary action of the solder. Flux should be applied to the area which can then be heated until it is at a temperature to melt the solder or spelter on the metal. With most metals and most silver solders this will mean virtually a dull red colour; if work can be carried out in low light the change of colour will be easier to see. As with lower temperature work the solder must flash away on the metal and not form lumps. If lumps form then the joint may not be sound.



These are known as 'Cyclone' burners. They take air in through the holes in their bases and so allow work to be carried on in areas where the air supply might be limited. They also have the somewhat strange (but very beneficial) effect of curling their flames all the way round tubes, thus giving a good overall spread of heat.



A small set of oxygen/propane equipment. Whilst the addition of oxygen to the propane increases the heat considerably and makes the flame easier to direct accurately, this particular set lacks sufficient volume for work such as boiler-making. It is, however, very useful for making boiler fittings, jewellery and other small tasks, making a much neater job than the normal blowtorch.

Unightly work

One difficulty with high-temperature work like this is the fact that the metal disperses the heat and so there is a tendency for solder to run to parts where it is not required. This is both unsightly and wasteful. Care must be taken when fluxing not to get flux all over the place which will encourage the effect of running. A lead pencil drawn round the joint area, say about $\frac{1}{8}$ of an inch away, will largely prevent solder running beyond it. But if excessive heat is applied, and it is difficult to judge things exactly to prevent it, then the pencil mark will not entirely prevent the run. A very useful alternative is typing correction fluid, a white substance which is painted on and which really does prevent runs completely.

The materials

Finally, let us look at the material we will use for our hard soldering. There are a number of manufacturers of such solders, the two main ones probably being Johnson Matthey and Fry, although the Sheffield Smelting Company also makes a good range. Various grades melt at differing temperatures and we need to select the grade most suitable for our work. At one time it was thought that there was a need to use differing solders as various operations progressed, particularly in boiler-making, the idea being to use a very

high temperature solder for the first operation, then a lower one and lower one still and so on. We now realise that this is not always necessary; once silver solder has melted and done its work it requires reheating to a considerably higher temperature in order to melt it again. So the same range can be used for several different heatings of the work without any great danger.

The manufacturers make a wide range of solders for industrial purposes and mainly the model engineer will only need to use about two or three different types. Most are alloys of silver, copper, zinc and/or cadmium but there are other small additions depending on the manufacturer. Fry make a range called Flowsilver; of these, Flowsilver No. 2 has a melting range of 610 to 620 degrees centigrade, the nearest equivalent in the Johnson Matthey Easy-Flow range being their No. 2 which has a range from 608 to 617 degrees centigrade. Because of their comparatively narrow melting ranges, these solders are ideal for the model engineer for all general purpose work.

If higher temperatures are required, we need to go to the Johnson Matthey Silver Flow range and here Silver Flow 24 with a temperature range of between 740 and 780 degrees is a useful solder; Flowsilver 34 is the nearest equivalent in the Fry range.

Fluxes

It is important to use the correct type of flux. In the case of brazing with spelter it is difficult to improve on ordinary Borax. For most silver soldering the Easy Flow range of fluxes is ideal. The green label Easy Flow is suitable for the lower temperature solders such as Easy Flow No. 1 and No. 2. For higher temperature work, as with the use of the Silver Flow range, then Tenacity No. 5 is best, this being able to sustain the higher temperature and longer heating time. In view of the fact that the equipment available to model engineers is not always as suitable as we would like and can take longer to heat the work than is desirable, it can be useful to use Tenacity No. 5 for the lower temperature solders as well. It will work quite well with them and overcomes the difficulties that can be experienced when it takes a long time to reach the required temperature.

There are various ways of applying the flux to the work. A simple way is to heat the solder and simply dip it in the dry powder. A quantity will stick to the solder and this can be applied to the work where the flux will run into the joint prior to the solder. In fact, Fry make ready-fluxed silver solder rods. Working in this fashion can be a little untidy as the flux is inclined to run all over the place and the solder follows it. There is a lot to be said for applying the flux before heating the work; in this way it can be put exactly where we need it. This again gives good reason for the use of Tenacity No. 5 which will remain in good condition while heating takes place. If the flux is mixed with water, joint penetration will be improved, but there is a chance in this case that, as the water boils off, the flux will run around and again be followed by our precious silver solder. Mixing in a little washing-up liquid helps it flow into the joint but it is still inclined to bubble off and run where not required. Mixing the flux with methylated spirit will ensure a good penetration and, as the spirit evaporates as soon as heat is applied, the flux tends to stay a little more

in the joint where required. It is largely a matter of experimenting to see what suits best.

High temperature soft solder

Before leaving the question of silver soldering and brazing, a thought should be given to the Johnson Matthey range of high temperature silver-bearing soft solders. These fit into the range between ordinary soft soldering and brazing. There are two types that can be very useful: LM15 with a temperature range of 338 to 390 degrees Centigrade and Comsol which has a single temperature melting point of 296 degrees Centigrade. Whilst LM15 has the greatest strength, generally on copper and brass, Comsol is probably the best type to use. Special fluxes are available for use with these solders – they cannot, of course, be applied with soldering irons.

Safety

Finally, we must inevitably come to the question of safety. Care must be taken to prevent burns from either the work in hand or hot material falling from the brazing bench. This means wearing some form of overall and stout shoes while working. Check all appliances for leaks, as leaking gas cylinders can cause explosions, and keep clear of all fumes – the fumes given off from silver soldering processes can damage one's health. In the main, such fumes are caused by overheating of the work and a mask will help prevent them being absorbed. The alternative is to use cadmium-free silver solders which are made by all manufacturers but they are in the higher temperature ranges such as the Silver Flow alloys.

This is an oxy/propane set of larger proportions. With the addition of an ordinary propane burner as back-up heat, it could be used successfully for boiler-making. A range of nozzles adds to its versatility.



A VISIT TO JACK SEALEY LTD

MEW dropped in recently on one of the largest wholesalers of engineering machines, tools and accessories in the UK. Ask for their splendid catalogue next time you're in your toolshop.



One of the workshops at Sealeys; all their technicians are thoroughly trained in the repair and maintenance of Sealey products.

The name Jack Sealey may be well-known to some readers but new to others. However, those in the latter category could well have purchased equipment supplied by the firm without realising it!

Whilst the motor trade is the most likely place where Sealey equipment will be found, a visit paid to their extensive warehouse and office block in Bury St. Edmunds proved enlightening as they actually supply a considerable amount of equipment likely to be of interest to the model engineer.

They are wholesalers of a vast range of engineering items, some of British

manufacture and others imported from all over the world. They do not sell direct to the public but have over four thousand retail outlets. It is therefore worth asking at any engineering outlet for a free copy of the catalogue which lists the range at present available. It is an ever-increasing range so it is also worthwhile trying to keep updated with catalogues.

So vast is the range of equipment supplied that it would be an embarrassment to try to list it all. Certainly there were many goodies to be seen in the warehouse. The range goes from hand-tools to a mill drill, the latter of far-eastern manufacture. It includes drilling machines



A mouthwatering sight! Just a section of the seemingly endless racks of materials kept in stock. Sealeys service over four thousand retail outlets all over the British Isles - their items are probably on the shelves of yours!



The firm keeps a large selection of small tools and safety equipment. Among the colourful safety gear are welding hoods, gloves, goggles and glasses plus respiratory protection items, all illustrated above.

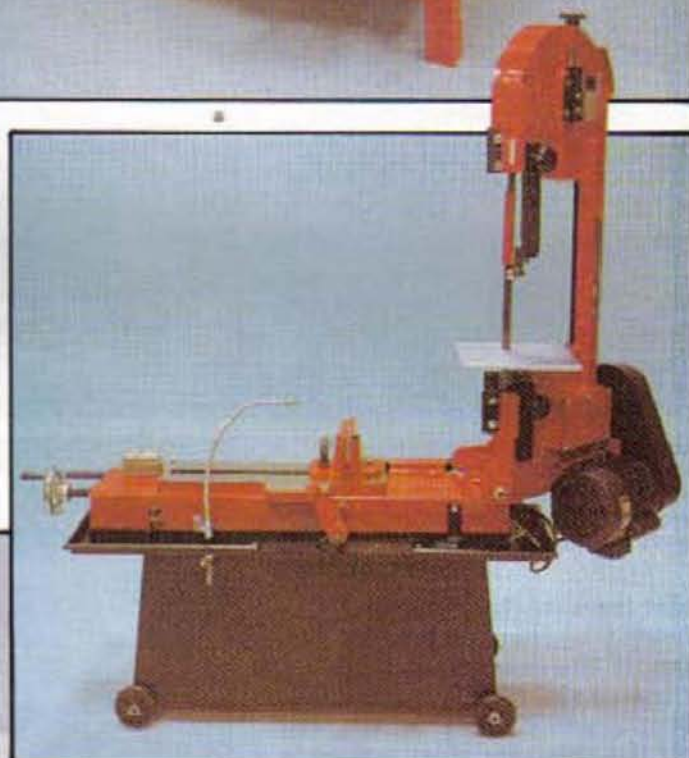
of which some seven thousand a year are sold and a range of power hacksaws, including the ever popular vertical/horizontal type of bandsaw.

The handtool range includes some unusual items such as Allen keys in a wide range of sizes which are fitted with handles and so prevent those irritating losses. There are all the normal tools as well as the specials. A complete range of welding equipment, both electric and gas, is also available.

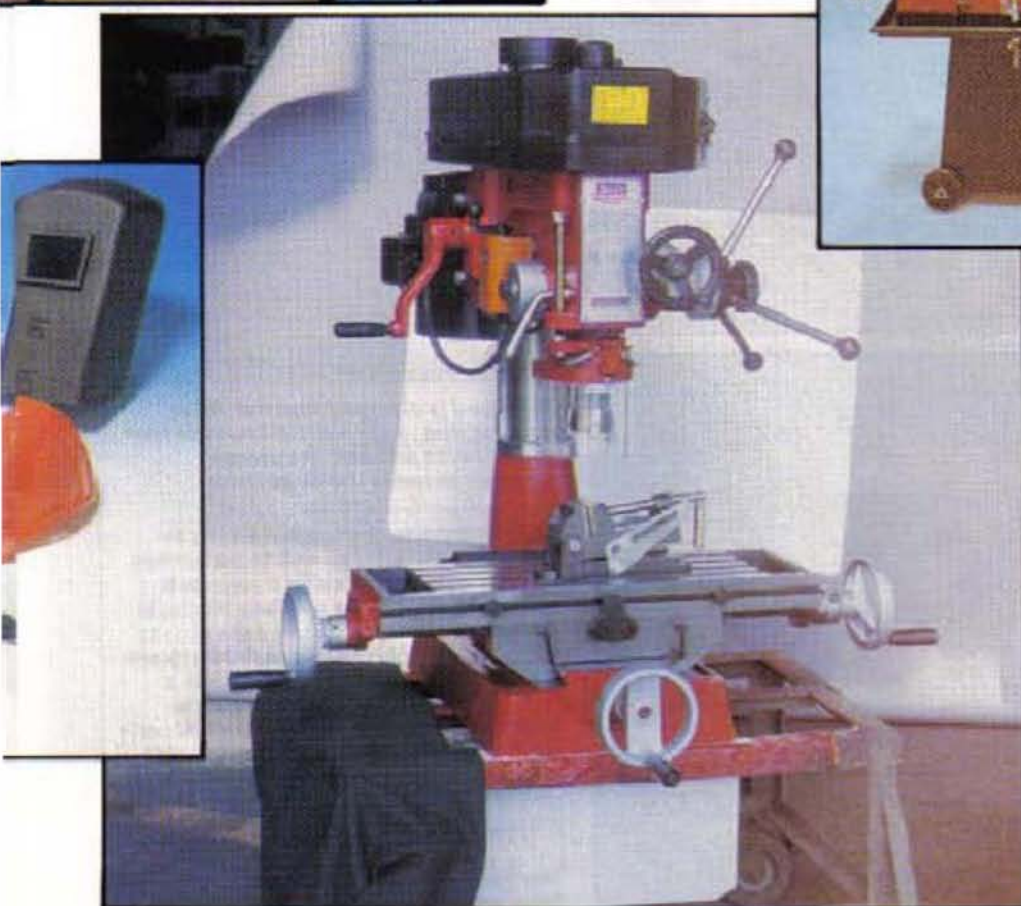
The firm operates a large fleet of lorries and orders are dealt with immediately and



There is a wide selection of benches and drilling machines (like these above), to say nothing of larger pieces of machinery like this milling machine (below). Of far eastern manufacture, it conforms, nevertheless, to Sealey's exacting standards.



One of Sealey's most popular lines – their versatile vertical/horizontal band saw.



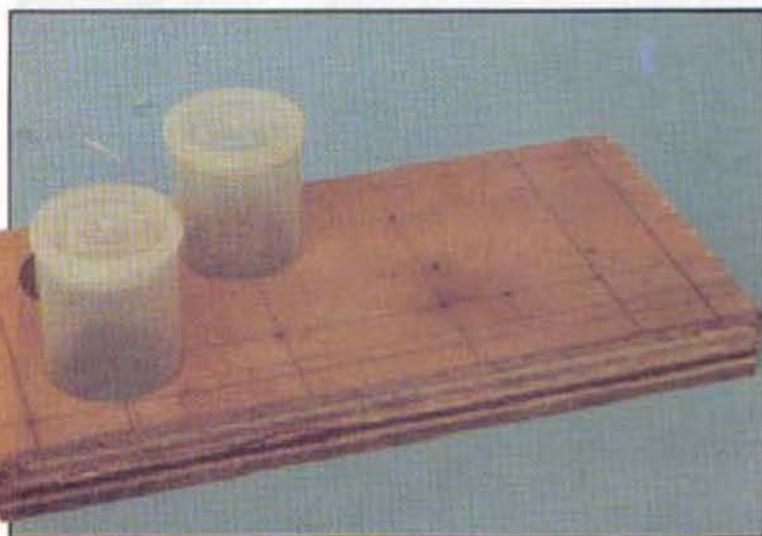
so should be with the retailer in a matter of a day or so of order. Stocks are deliberately kept at a high level so that this policy can be maintained.

One other thing that was remarkable was the back-up service the firm could offer. A complete range of spares is available for virtually everything they sell. They have their own workshops which will deal with any major problems, and service vans which travel around to carry out work on site.

All the staff are in-house trained; this includes the sales staff so that they have a thorough knowledge of the goods they sell – quite a rare thing these days.

The larger items sold by the firm are distinctive in their red finish with the firm's blue logo prominently displayed leaving little doubt that it means what it says – "Sealey Quality Tools"!

SMALL PIECE STORAGE



The photo above illustrates how the canisters rest in the bottom of the holder. This 'prototype' was made before it was discovered that the best way is to drill the four outer holes first.

Next time you load up your 35mm camera with film, don't discard the cassette canister. These useful plastic containers, complete with snap-on lids, are just the thing for storing a wide range of small bits and pieces around the workshop.



The wood is clamped together after marking one piece out. Drill out the four corner holes and bolt the pieces together to make the large holes.



The storage of small items such as nuts and bolts as well as parts made or obtained for various projects is always something of a problem. No doubt readers press into service all sorts of container; the tobacco tin is a firm favourite because of its shape and size but it is a little too large for those very tiny parts. Matchboxes can be used but very tiny parts slip between the wood and paper, or else jump out and run away when the box is opened. Almost any small container can be pressed into use. No doubt the canisters

The finished rack makes a useful hold-all for screws, washers, etc.

used here in which we get 35mm films are used by many model engineers, they being an ideal size with a lid that will not slip off. The only difficulty is to keep track of the actual containers when they have been filled with those precious bits! They tend to spread themselves all over the workshop, surfacing months after a new lot of bolts has been bought, or replacement parts made.

The holding rack

This absolutely simple device which anyone can make utilises 35mm film containers and scrap wood plus a tiny piece of tubing. The idea, which was developed from one by Allan Turner, ensures that things can be found as and when they are required. The measurements shown work out right for the containers and if anyone wants to enlarge the size of the unit, it is just a case of increasing the length or width proportionally. It has been found that it is convenient to keep the rack on the small side and make several, as large ones need space in which to store them. The final size, therefore, must be for the reader to decide. If difficulty is found in obtaining containers, ask at your local photographer – the one that takes photographs, not sells cameras. They get them by the dozen and many will be only too willing to give them away. Some make a small charge.

Top and base

The top and base are made from three pieces of wood, the size shown is 6mm

plywood but it need not be as thick as that by any means and 4mm would do. There is no reason why hardboard should not be used if plywood is not readily available, as little strength is needed. The top is a single sheet of the material and the base is two separate sheets. One of these and the top are clamped together as they will be identical. Mark out one sheet and drill the four corner holes for the screws. Clamp the parts together and drill through the second piece of wood or hardboard, so that four nuts and bolts can be put through to hold the two pieces together. Once they are securely held, drill the 30mm diameter holes for the containers. These can be done in a variety of ways. A hole saw is the ideal thing on plywood as it does not cause it to splinter or alternatively a trepanning tool or one of the patent cutters that can be bought at tool stores can be used. As a third option the holes can be sawn out. Those with a fine jigsaw will find it easy, but even with a coping saw it is not all that difficult. The bottom part is just a plain piece of wood or hardboard.

Assembly

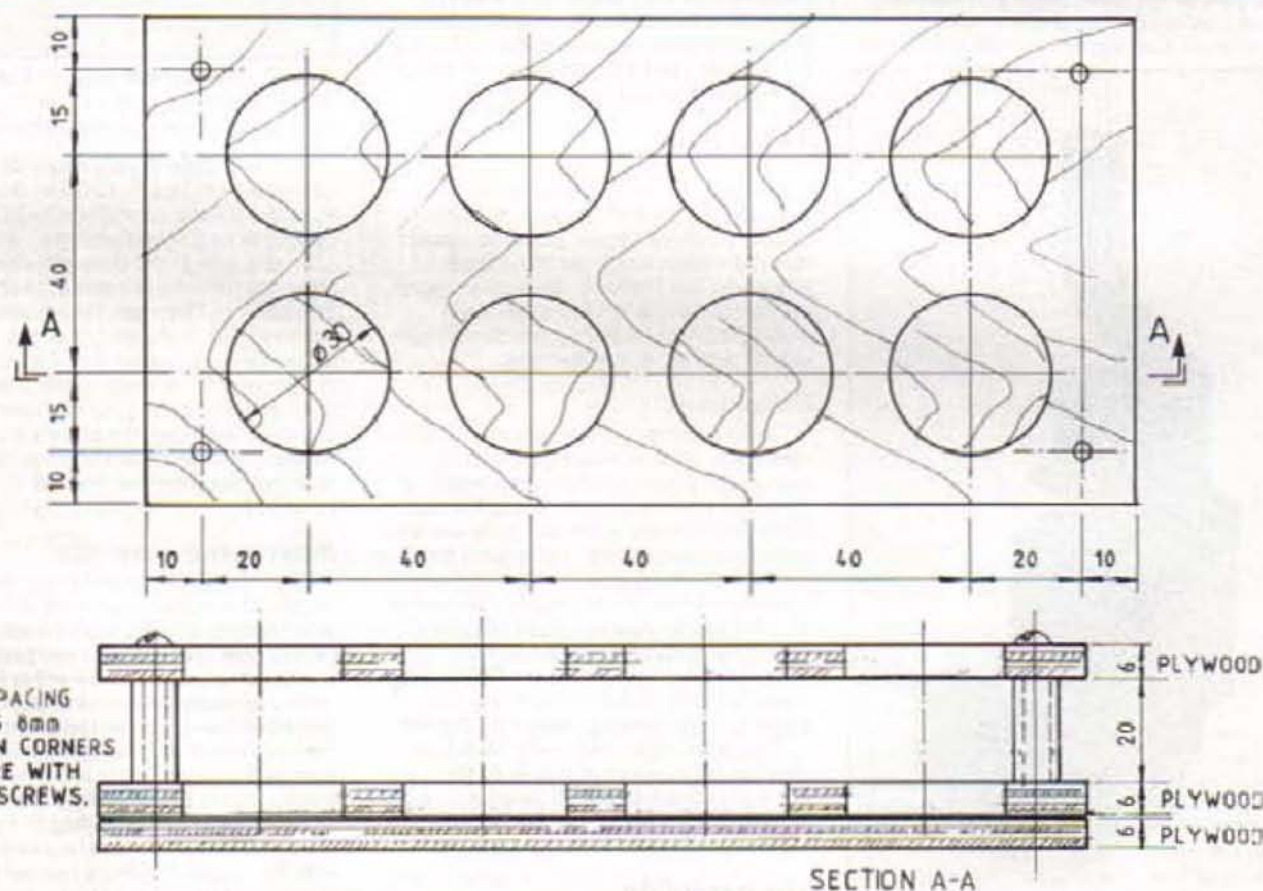
Cut four lengths of suitable tube for the pillars to separate the two parts and simply screw through with wood screws. If the thinner material is used, it may be necessary to put nuts and bolts right through instead of using wood screws, and almost certainly this will be necessary if hardboard is used. Apart from ensuring that the four pieces of tube are of identical length the only thing that needs care is to

ensure that the two pieces which were drilled together remain the same way round – otherwise the canisters will look like miniature leaning towers of Pisa! That is, unless someone is an absolute wizard with marking out and drilling and can get both absolutely identical.

The canisters should be a tight sliding fit in the unit. Marking details of the contents on them with marking pen is not a good idea as it rubs off after a time and little labels stuck to the lids is the best way of identifying the contents. So there we are – a simple quickie of a job which will repay the little time spent a hundred times over.

QUICK TIP!

For mating parts with precision it is usual to coat them with engineers' blue (not marking blue) and put the parts together. Where the blue rubs off, a high spot is indicated. A useful alternative to engineers' blue is to allow the soot from a lighted candle to collect on the components to be mated. The effect, when parts are put together, is the same as with engineers' blue and a lot cheaper and more convenient!



SIMPLE STORAGE RACK FOR SCREWS ETC
LENGTHS & WIDTHS SHOWN AS GUIDE ONLY
MAKE TO FIT ANY CONVENIENT SPACE USE
FILM CASSETTES IN HOLES AS STORAGE UNITS

HAND MILLING ATTACHMENT

Les May is a highly qualified engineer as well as an established model engineer. Now retired, he spends much of his time in his workshop either making models for himself or for other members of his club. He is full of ideas for getting greater precision in the home workshop. This little milling device can be used for all small milling work and is not expensive to build; in particular, the author uses it for making very small milling cutters. As an added bonus we are treated to his method of making dovetail slides without the use of any particular equipment and which in itself is worth remembering!

I needed a slot drill for cutting a $\frac{1}{8}$ in. keyway. Such a thing may be available commercially, but it certainly was not an 'off-the-shelf' article in our locality. Having turned the blank, a home-made cutter seemed to be the best solution. I made a couple of attempts at cutting the teeth with a square needle file, but the results were far from satisfactory. This was mainly because, when using my thumbnail as a guide for the file, it completely obscured the view of the cutter blank and accurate filing was impossible under these conditions. I returned to the lathe and tried

mounting a lathe tool on its side in my four-way tool post and this showed promise, but I found that in packing the tool to the correct height I was short of the range of shims necessary to give the accuracy required.

What was really wanted was a small milling head with some degree of vertical adjustment. I thought about this. How could I arrange the motor? Had I even a suitable motor? No suitable motor was available and the thought of the work necessary for producing brackets, belt tensioning devices, pulleys, etc., put me off the idea, so I put it out of my mind and got on with another aspect of the job.

The solution

Having stepped back from the problem for a while, the answer was obvious. To remove such a small amount of metal certainly did not require electrical power; hand operation would be more than adequate. The Draftette was got out again and the drawings for a suitable hand milling attachment were produced almost in their entirety in one evening.

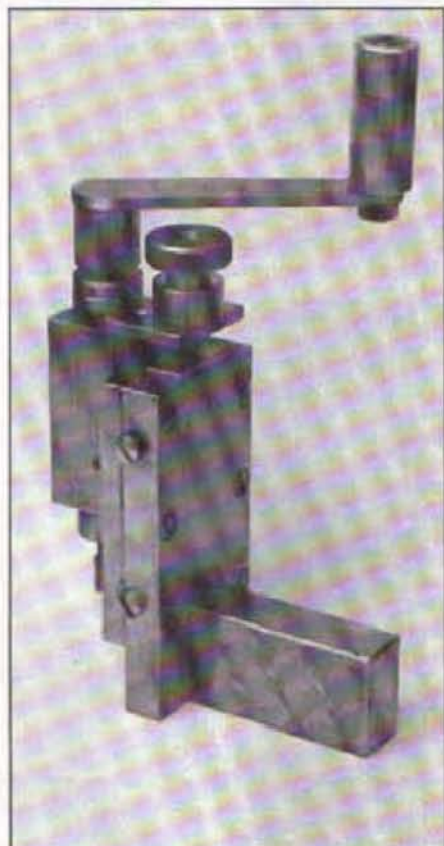
Other uses

Since making it, I have found additional uses for it, such as making a machine reamer for a non-standard dimension (necessary when reconditioning the club locomotive); many more slot drills and end mills, much larger than the original one that sparked off the idea; a trunk guided cross-head for a small launch engine; hexagonal keys for cap screws and short lengths of hexagonal mild steel when I have, inadvertently, run out of stock. Obviously, a prerequisite for most of these items is some form of indexing device for the lathe.

The attachment was made for a 5 in. Sheldon lathe, which is similar to the Boxford or Southbend, so those who want to make it for a Myford or similar lathe will have to adjust the dimensions somewhat.

The baseplate

Item one is the baseplate. This is made from a piece of bright mild steel $1\frac{1}{2}$ in. $\times$ $\frac{3}{4}$ in. $\times$ 3 in. long. If the type of clamping shank shown in the drawing is required, a slot nominally $\frac{1}{8}$ in. wide by $\frac{1}{4}$ in. deep must be milled in the back to suit the shank. If you



A three-quarter rear view of the milling device which illustrates the arrangement for holding it in the lathe.

have only a lathe at your disposal, the slot can be substituted by two $\frac{1}{8}$ in. dowels at $\frac{1}{2}$ in. centres and a central cap head screw about $\frac{1}{8}$ in. or 6 mm diameter.

In one side of the base plate two 4 BA holes are drilled and tapped, as shown on the drawing. These are for adjusting the dovetail strip. In the end opposite to the milled slot a clearance hole 6.5 mm or 0.265 in. diameter $1\frac{1}{4}$ in. deep is required, this is to be counterbored 0.313 in. diameter by 0.18 in. deep to take the bronze nut, item 9. Finally, the three drilled and counterbored holes for the dowelled dovetail strip are to be drilled.

Making the dovetails

The next three items all require dovetail angles. These always present difficulties with holding securely whilst machining is carried out. The following method, which can be adopted for use on either lathe or milling machine, may be found helpful. It is described for use on the lathe. You will require a piece of 1 in. square mild steel, approx. 2 in. long. This is to be held lengthways in the four-jaw chuck off-set by $\frac{1}{4}$ in. and bored a snug sliding fit for $\frac{1}{8}$ in. diameter. This bore must be exactly parallel with the face of the block opposite to the direction of the off-set. When this is done, it is cut in half.

A $\frac{1}{8}$ in. BSF hole is tapped into one face of each of these blocks so that they can be fixed to the faceplate with the offset towards the tailstock of the lathe. The photograph shows the general idea.



This view of the device clearly shows the spindle and adjustment arrangement.

Through one of the faces at right angles to these faces, another $\frac{1}{2}$ in. BSF tapped hole is required in each block on the centreline of the $\frac{1}{2}$ in. hole. These are to take locking screws, which will secure a piece of $\frac{1}{2}$ in. diameter rod, about 5 $\frac{1}{2}$ in. long. Before proceeding any further, the $\frac{1}{2}$ in. diameter rod should be normalised. This will prevent the rod from warping when it is machined. Just heat it to dull red heat and leave it on the hearth to cool naturally.

Polish off any slight oxide film, then assemble the rod with its two blocks, and bolt the assembly across the centre of the faceplate. The blocks must be at least 4 in. apart. Take a series of facing cuts as close to the two blocks as possible until the flat on the bar is about $\frac{1}{4}$ in. wide. When this is done you can loosen the locking screws, remove the $\frac{1}{2}$ in. rod from the blocks and

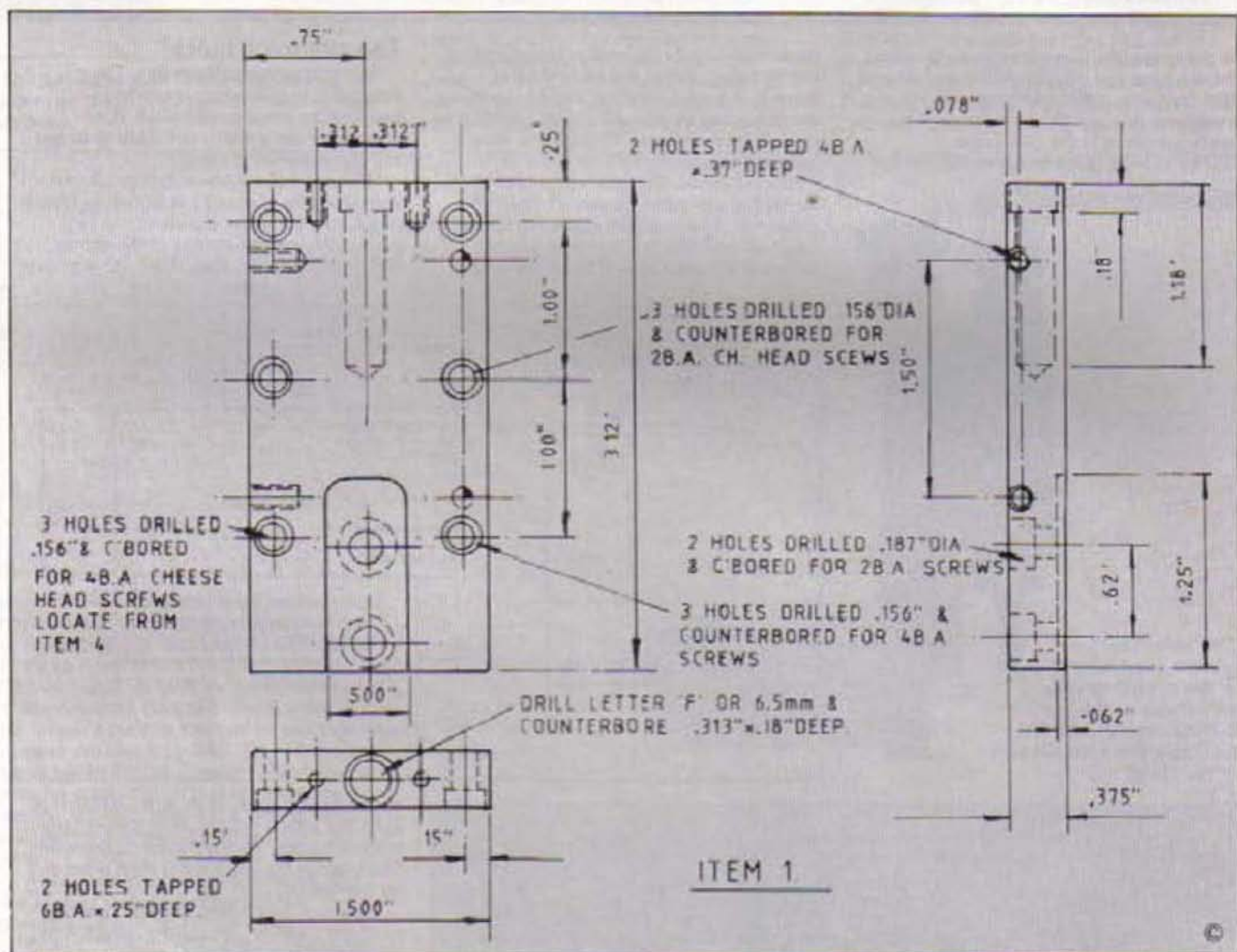
difficulties, you can make the dovetail piece as a separate item from the main block. Unfortunately, it will be necessary to machine down a piece of 1 in. $\times \frac{1}{2}$ in. mild steel to 0.265 in. $\times 0.968$ in. for this. Drill and tap two 4BA holes on the centre line and at 1 in. pitch to match the holes in the machining jig. Set the machined face on the jig at 90 degrees to the faceplate, then secure the part lightly to the jig. Set the edge of the part parallel to the faceplate using a dial test indicator.

Make sure that the two fixing screws are really tight, then tilt the bar with the dovetail piece on it to 60 degrees to the faceplate using a protractor and bevel. Take a series of light facing cuts until you just have a sharp edge and no more. Tilt the jig to 60 degrees in the opposite direction and repeat the operation. The machining of this

the centre of the block on the thickest side. The two holes for 4BA screws can be spotted through the dovetail and drilled and tapped 4BA. With the screws in place, two $\frac{1}{2}$ in. dowels at 1 $\frac{1}{2}$ in. centres can be fitted at the extreme ends of the block. (It does not matter that these fixing holes break into the bore. They will show very little when the complete tool is assembled). This should make the assembly quite rigid enough to withstand the cutting loads of the small end mills to be used in the fixture. All that remains to be done now is to drill and plug the oil holes as shown.

Dovetail strips

Items three and four are the dovetail strips. These are made from $\frac{1}{2}$ in. $\times \frac{1}{2}$ in. bright mild steel and, before any machining work is carried out, they should be



drill it to match the 0.156 in. diameter holes in the base plate by using the plate as a jig. With the machined face set at 60 degrees to the faceplate, you will be able to machine the dovetail angles on the three items requiring them.

The spindle block

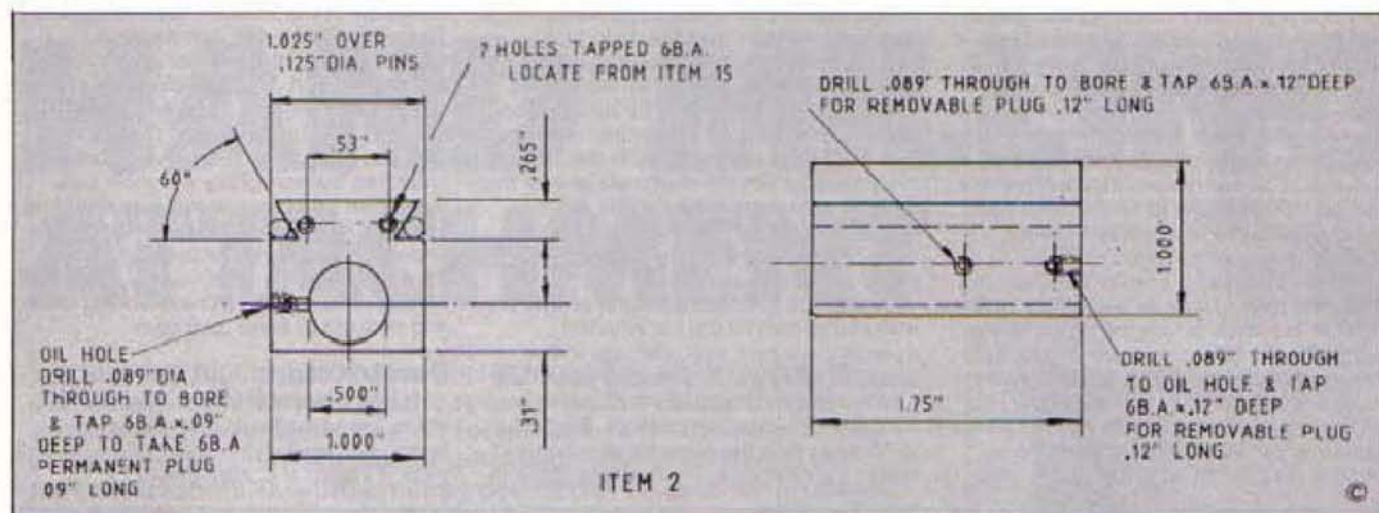
The spindle block, **item two**, is best machined in one piece. Those who have a milling machine or shaping machine will have no difficulty in producing this part from the solid. If you have a 60 degree angle cutter, milling is probably the quicker method, but the shaper requires no special tools, only ability to grind toolbits to the desired shape necessary. If this presents

first dovetail piece is now complete. The 4BA tapped holes must now be drilled out to clearing size and countersunk for 4BA screws.

The main block must be dealt with next. Mark off the position of the 0.500 in. bore hole and set it accurately in the four-jaw chuck, ensuring that the faces of the block are parallel to the lathe travel by using a test indicator. Bore the hole and face the end. Change to the three-jaw chuck and turn a 1 in. long mandrel a hand tight fit in the block, push the block on to the mandrel and face the opposite end to an overall length of 1.75 in.

The dovetail piece must now be accurately positioned and clamped down

normalised. One of the strips, **item three**, is to be clamped to the baseplate on the side which is shown dowelled. The edge of the strip and the edge of the baseplate must be exactly flush with each other before the three 0.156 in. diameter holes are spotted through on to the strip. Drill them through 0.116 in. (number 32 drill) or 3.0mm and tap 4BA. Fit the screws, recheck the two edges, then drill, ream and fit the two $\frac{1}{2}$ in. dowels. Remove the strip and fix it to the machining jig and carry out the same routine as described for the spindle block dovetail, except that only one edge is machined, of course, and instead of machining to a sharp edge, a land 0.030 in. wide must be left. Reassemble the strip on



to the baseplate. The other strip, item four, must be marked off and drilled and tapped 4BA for fixing to the machining jig. Having machined this in a similar manner, it is ready for fixing to the baseplate.

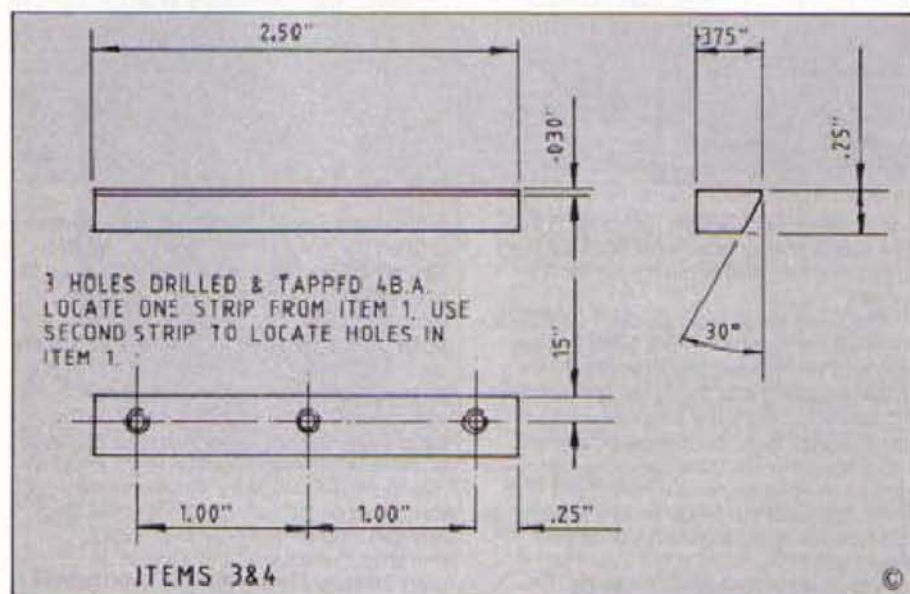
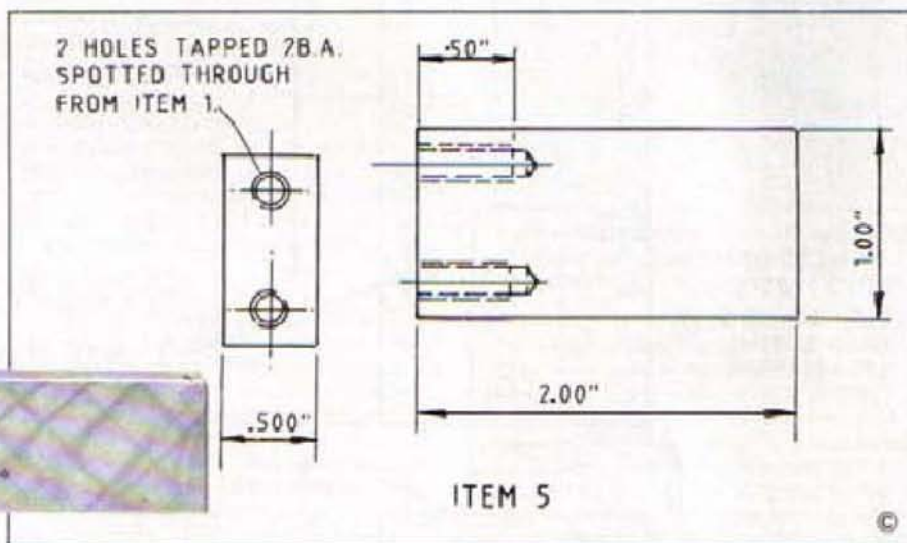
The spindle block must be held on the

baseplate with its dovetail pressed against the first strip. When the second strip, item 4, is added, its edge should overhang the baseplate by about 0.020 in. Clamp it in this position and spot through the 4BA tapped holes on to the baseplate. Drill through 0.356 in. diameter and counterbore for 4BA cheesehead screws to match the other side. The two 4BA adjusting screws can now be fitted and the strip can be adjusted to give a sliding fit on the block.

The clamping block

We come now to item five. There is little point in going into great detail because, as mentioned before, it will almost certainly need modification to suit the particular lathe used.

The point to be borne in mind is that, with the slide at about $\frac{1}{2}$ in. above its lowest position, a cutter projecting about $\frac{1}{2}$ in. beyond the spindle comes at the centre height of the lathe. Also, if you have a lathe

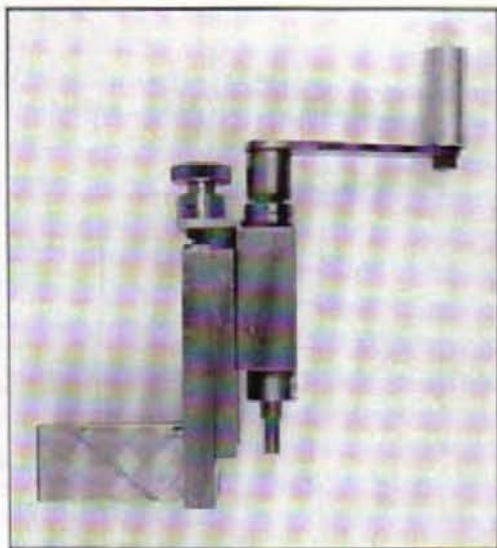


with a boring table, such as the Myford or Zyto, the attachment is more conveniently placed in a rear toolpost beyond the work. The view of the work is not then obscured by the fixture.

The next four items, numbers six to nine, are relatively straightforward turning operations. It is alright to use taps and dies on these threads providing that you make sure that the threads are cut square to the axis by starting them in the lathe.

The index collar

The index collar, item seven, is a little more unusual in that it has an 'O' ring groove in the bore and index marks on the outside diameter. The 'O' ring provides sufficient friction between the screw and collar to prevent movement during normal use. The 'O' ring most suitable has the following nominal dimensions: inside dia. $\frac{1}{2}$ in., outside dia. $\frac{3}{4}$ in., section dia. 0.070 in. The groove should be machined 0.075 in. wide by 0.065 in. deep, and the best way to do it is to grind a tool 0.075 in. wide on the end



The opposite side of the slide is left plain, as there is no need to lock at both edges.

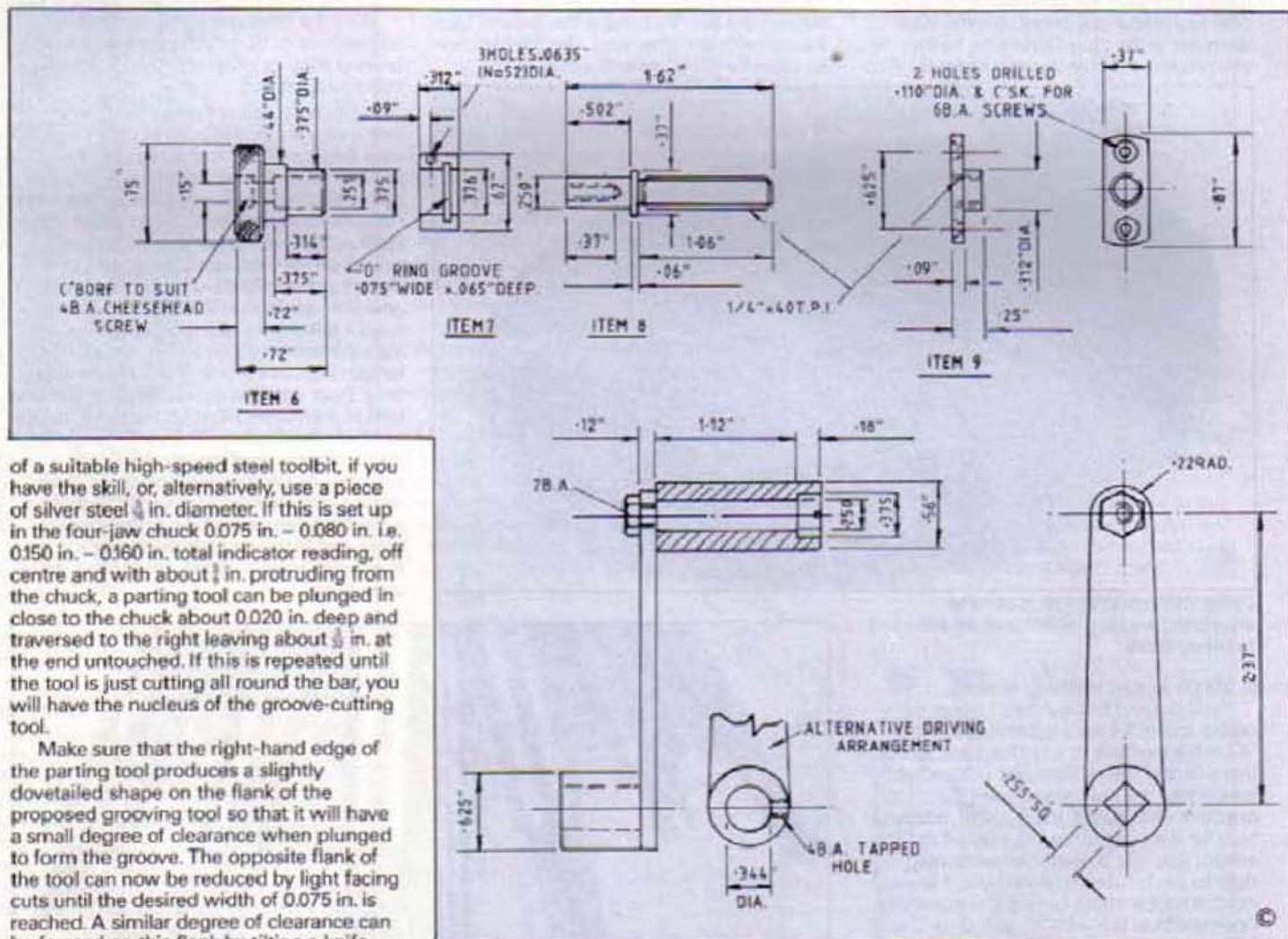
from rubbing. The tool is now ready for hardening and tempering.

Heat just the turned area until it is a full red turning to orange. Plunge it into clean cold water, then test with an old file. If it is impossible to file, give the turned shank a polish with a $\frac{1}{4}$ in. wide strip of fine, clean emery cloth. Wrap this same strip over the end of a flat needle file or even a small piece of wood and give a light polish over the top surface of the tool. Make sure that you do not damage or blunt the cutting edge. Also, do not touch either of these polished areas with your fingers, or anything else for that matter. Direct the blowtorch flame at the $\frac{1}{4}$ in. rod about 1 in. away from the turned area, but do not let the flame touch it, keep the tip of the flame about 1 in. away from the rod. After a while a straw colour will progress to the turned shank diameter, which you have polished earlier. When this has reached the cutting edge, quickly plunge it into clean cold water. Cut the $\frac{1}{4}$ in. silver steel through at about $2\frac{1}{2}$ in. - 3 in. away from the turned part and you have a grooving tool, which

leave the best possible finish on it.

The next thing to do is to prepare the lathe for the indexing operation. Set up a changewheel having either 25 or 50 teeth on to the first or stud wheel of the screwcutting train. A piece of $\frac{1}{2}$ in. $\times$ $\frac{1}{4}$ in. bar with a beak-shaped piece fixed across one end and a hole to suite a changewheel stud at the other will provide a reasonably positive location for the gear teeth. Obviously, to provide the 25 divisions required, every tooth of the 25 wheel is used and alternate teeth on the 50 wheel. The 50 wheel will give slightly more accurate results. A more rough and ready alternative is to use a scribing block standing on the bench close to the lathe changewheels and use this to locate the teeth by eye.

A Vee-shaped tool set sideways in the toolpost is used for the marking. The top slide is set parallel to the lathe bed, the saddle is locked and the first mark is made right across the collar using the top slide. The next four marks are stopped at about 1 in. long. Noting a suitable reading on the



of a suitable high-speed steel toolbit, if you have the skill, or, alternatively, use a piece of silver steel $\frac{1}{8}$ in. diameter. If this is set up in the four-jaw chuck 0.075 in. – 0.080 in. i.e. 0.150 in. – 0.160 in. total indicator reading, off centre and with about $\frac{1}{8}$ in. protruding from the chuck, a parting tool can be plunged in close to the chuck about 0.020 in. deep and traversed to the right leaving about $\frac{1}{8}$ in. at the end untouched. If this is repeated until the tool is just cutting all round the bar, you will have the nucleus of the groove-cutting tool.

Make sure that the right-hand edge of the parting tool produces a slightly dovetailed shape on the flank of the proposed grooving tool so that it will have a small degree of clearance when plunged to form the groove. The opposite flank of the tool can now be reduced by light facing cuts until the desired width of 0.075 in. is reached. A similar degree of clearance can be formed on this flank by tilting a knife tool inwards towards the chuck, say two or three degrees. Before taking the $\frac{3}{8}$ in. silver steel rod from the chuck, the point of maximum eccentricity must be marked by lightly drawing the knife tool across the end face from the centre outwards.

The next thing is to file down to the line just made to leave a D shaped piece on the end of the rod. This filing can extend about $\frac{1}{8}$ in. or so up the turned shank. A little additional clearance can be filed at the front of the tool, just sufficient to stop the tip

will produce the required width of groove with no problem. The lathe cross slide index collar can be used to control the groove depth and the top slide collar can control the position from the end of bore.

Marking the collar

Now that the bore and 'O' ring groove are complete we can turn to the marking of the index collar. If the outside diameter of the collar is not running truly, take a light cut along it with a round-nosed tool to

top slide collar will ensure that they are all of equal length. When indexing, make sure that any backlash in the gearing is kept in the same direction. This process of one long and four short marks is continued until you arrive at the starting point again. The little curls of steel left at the end of each mark can be removed with your thumbnail and carefully filed smooth with a fine needle file.

Stamping the number with number punches is the next operation. If you take

your time and work carefully, you can position the punch with sufficient accuracy by eye. A lot of work is required to make a stamping jig and it is just not worth it, the time is better spent taking longer on the job to achieve the desired result. To finish this item it is only necessary to drill the three tommy bar holes. These need not be spaced at exactly 120 degrees. Arrange them at convenient points where they will not conflict with the numbers.

The cutter spindle, Item ten

The cutter spindle is next on the list. The outside diameters and thread can be done with the $\frac{1}{8}$ in. bar held in the three-jaw chuck. All diameters, including the 0.62 in. diameter, should be turned at the same setting so there will then be no doubt about their concentricity. A good finish is required on the 0.375 in. bearing diameter to avoid rapid wear in use. It may be necessary to support the outer end with the tailstock centre if you are troubled with tool chatter. Drill the (No. 20) 0.16 in. dia. knockout hole to a depth of $1\frac{1}{2}$ in. only. Part off or hacksaw the job from the bar and, having swapped over to the four-jaw chuck, get the large diameter of the spindle running as truly as you possibly can using a test indicator. Aim

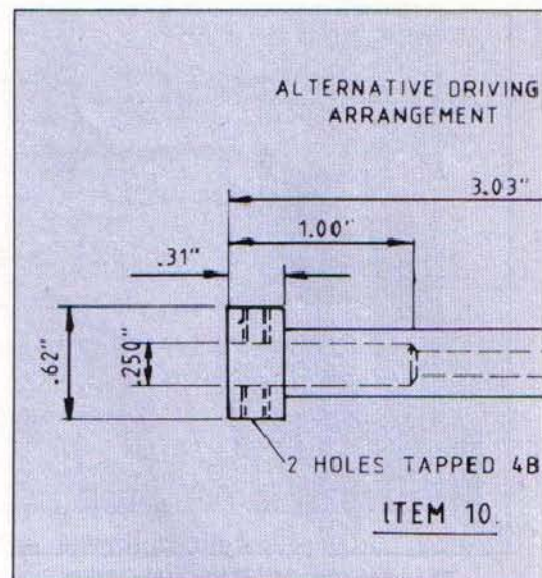
Allen grub screw each time you remove or replace the handle

Parts 11 – 15

Items 11 & 12 are straightforward turning operations and items 13 and 14 are simply pieces of plate cut to size and drilled and should need no explanations. With item 15 you have the option of drilling the 0.251 in. diameter hole using the lathe with the part positioned in the four-jaw chuck. This has the slight advantage of being then in the position to use the marking tool used previously for the graduated collar, for marking the index lines, which, for appearance sake, should be parallel with the long side of the plate.

The handle

The handle is the last part to be made. Filing the $\frac{1}{4}$ in. square hole in the boss may require a little patience, but if you have already tackled the drive square on the spindle, it will not prove too difficult. Good sharp square corners to the hole can best be obtained by grinding the teeth off one face of a square file so that really sharp corners are left. Try to keep the ground face square with the other two. The file can then be used for filing towards either left or



right. The alternative boss, if you make it, is just drilled 0.343 in. and a grub screw fitted.

With the boss complete, the next operation is to fix it to the plate with silver brazing alloy, or silver solder as it is more commonly known.

A $\frac{1}{4}$ in. hole drilled through the plate to take a very short piece of $\frac{1}{8}$ in. diameter mild steel $\frac{1}{8}$ in. long is all that is required to provide a location for the boss, which will stop it floating about when the solder runs. I use Johnson Matthey Easy-flo 2 and Easy Flo flux. Make the flux into a paste and paint it on the joint faces. Propane gas is almost universally used for this type of operation and you will find that you will need a burner not less than about $\frac{1}{2}$ in. diameter to bring the job to the melting temperature of Easy-flo 2 in a reasonable time. Even with this size burner it is a good idea to muffle the job round with fire bricks as much as possible. (If too much time is taken in heating up the job, the flux becomes ineffective and then there is no chance of the solder running through the joint.) Clean up around the brazed area, make and fit the shouldered screw and aluminium handle and that is the last detail completed.

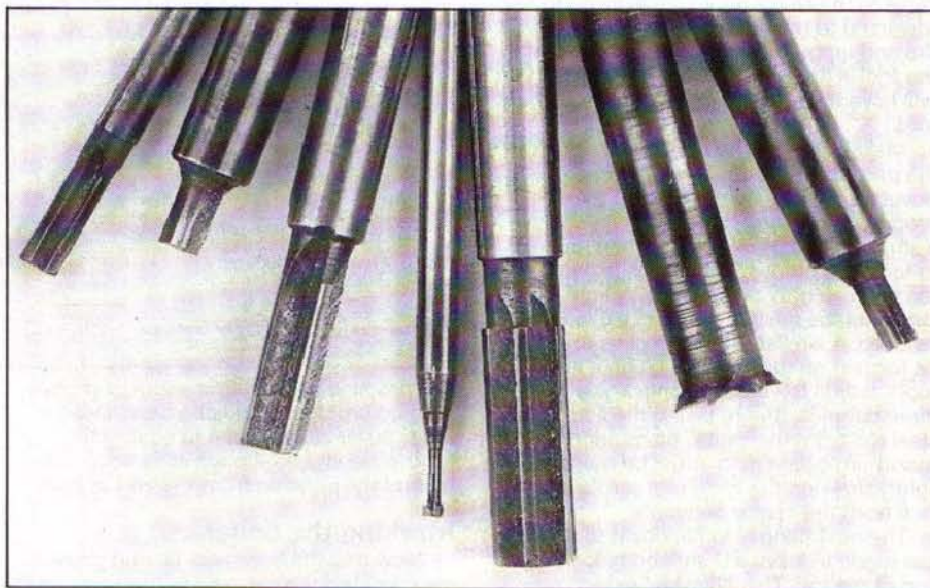


Using the faceplate to make the dovetails; an idea which can be adapted to many tools.

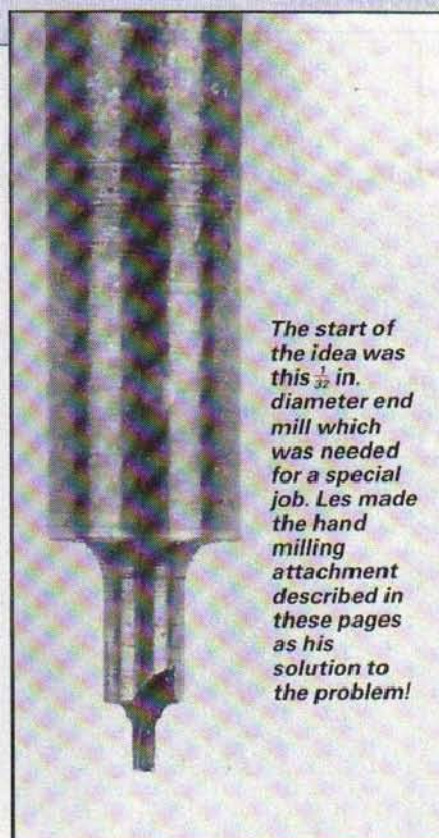
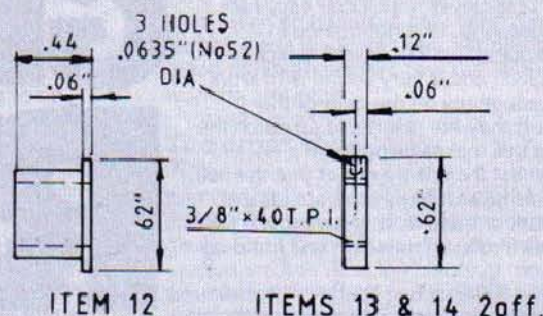
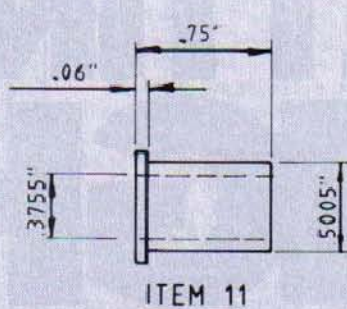
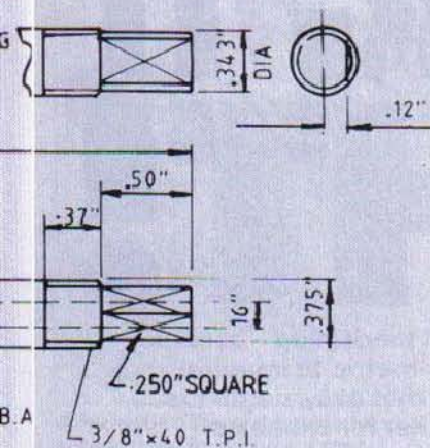
at 0.0005 in. total indicator reading.

Face the end to the correct dimension, centre and drill with a 0.235 in. dia. (letter 'A') or 5.9 mm drill to 1 in. deep and follow this with the 0.16 in. diameter drill until it breaks into the hole drilled from the opposite end. Ideally, the 0.250 in. diameter hole for the cutter should be bored to ensure that this diameter is maintained right to the full depth of the hole. If you are not too happy about boring, then carefully open the hole out with 'C' and 'D' or 6 and 6.3 mm drills and finally size it with a $\frac{1}{8}$ in. drill. The two 4BA tapped holes drilled opposite each other are for securing the cutter. When these are done all that is required is the 0.250 in. square drive piece. This is a good filing exercise and, carried out with frequent checks with micrometer and square, it is not too difficult to get an accurate result.

If hand bench work is not your favourite aspect of the hobby, just file a single flat. The only disadvantage of this is that it will be necessary to loosen or tighten a 4BA



A selection of the very small cutters which Les has made with the miller; the device enables him to fabricate these tiny items which would normally not be obtainable anywhere.

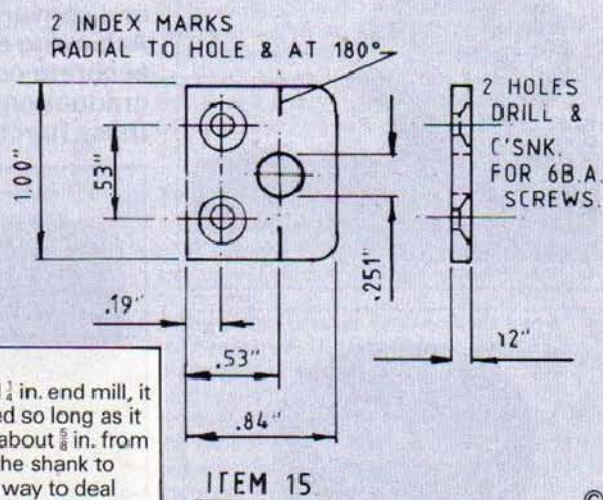


The start of the idea was this $\frac{1}{8}$ in. diameter end mill which was needed for a special job. Les made the hand milling attachment described in these pages as his solution to the problem!

Assembly

The assembly of the remaining details deserves a few comments. The nut, **item nine**, can now be located into the baseplate and its fixing holes spotted, drilled and tapped 6BA. The screw, index collar and knurled knob can be assembled through **item 15** and secured with a 4BA cheesehead screw. Screw the assembly through the nut as far as it will go. Slide the spindle block up to the plate, clamp it with a toolmaker's clamp, clear of one of the screw holes and spot through, drill and tap 6BA. Fit a screw into this hole as tightly as possible, then carefully spot through, drill and tap the second hole.

The whole tool is almost complete now. The two bushes are to be pressed into the spindle block, the longer one goes at the cutter end. Don't forget to drill the oil hole through the small bush and fit the plug to the hole. The spindle can now be fitted with the locknuts adjusted to give freedom of rotation with no perceptible end float.



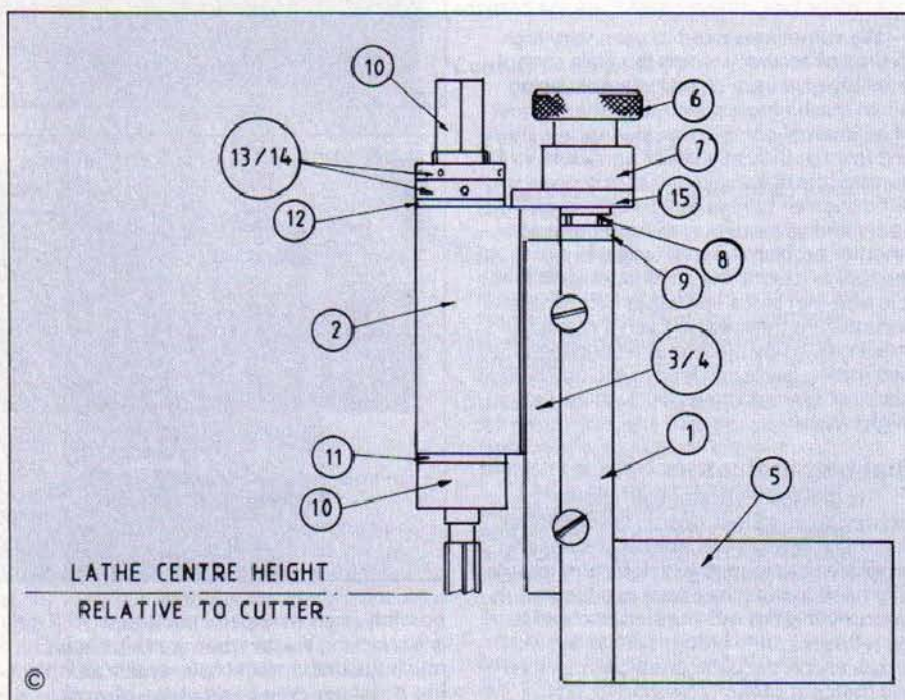
If you have a commercial $\frac{1}{8}$ in. end mill, it is possible that it can be used so long as it does not extend more than about $\frac{1}{8}$ in. from the spindle. Grinding away the shank to reduce its length is the best way to deal with the problem. At the speeds that I use on my little bench miller, I find that silver steel end mills and slot drills are perfectly satisfactory up to $\frac{1}{8}$ in. diameter, therefore, the greatest use for the attachment is in producing cutters of various types including machine reamers. A selection of these is shown in the photograph.

Using the tool

Now for a few words on using the attachment. There are two or three points to be observed: the first is to ensure that all slides other than the one in use are locked, i.e. the saddle and cross slide locked if the top slide is used for traversing. The second

point is accepted practice in all normal milling operations. The direction of feed should always oppose the action of cutter. Finally, light cuts of, say, 0.1 in. should be taken, although this figure is only given for guidance.

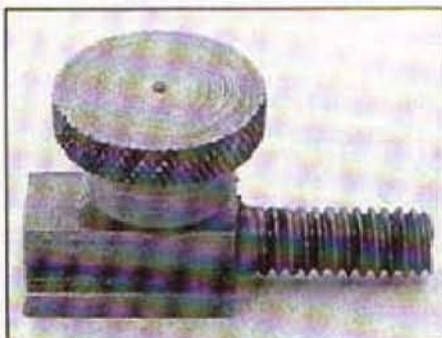
Experience is the best guide, but it is better to start gently if broken cutters are to be avoided. If by chance you do feel the cutter starting to 'hog in', don't turn it backwards, just wind the cut clear with the appropriate slide. Finally, I hope that you will find the fixture as useful as I have over the past couple of years since I made it.



To achieve a consistently high degree of accuracy is not all that easy for those who have not trained in machine operation. The advice which is usually given and is very sound is to work to the graduations on the dials of the machine. If they are resettable so much the better, as this makes using them a lot easier. Whilst there is no doubt that the use of the dials gives a fairly accurate idea of the amount of material being removed they cannot, as a rule, be relied on one hundred percent.

GETTING IT RIGHT!

This little article deals with two aspects of machining – accuracy and conversion from imperial to metric, or metric to imperial. Achieving really accurate results is not all that easy, neither is accurate conversion from one unit to another for which no graduations are available on the machine. However, to improve these functions is not difficult, as is shown here.

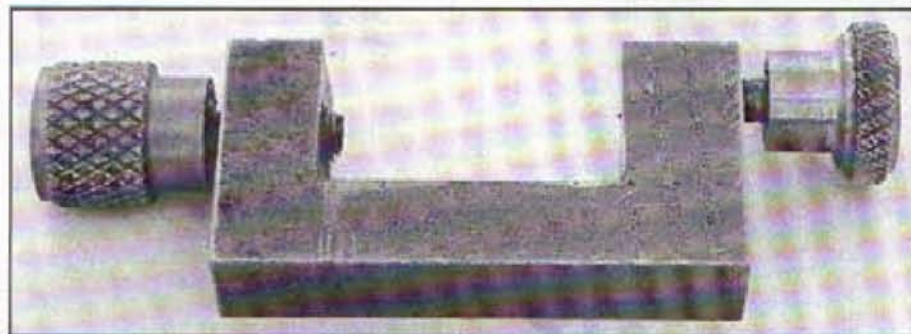


Top, a Tee nut with an extension thread on the side is useful for securing slotted steel to the cross slide. Above, this Tee nut with knurled screw is used for holding clamps to the milling machine.

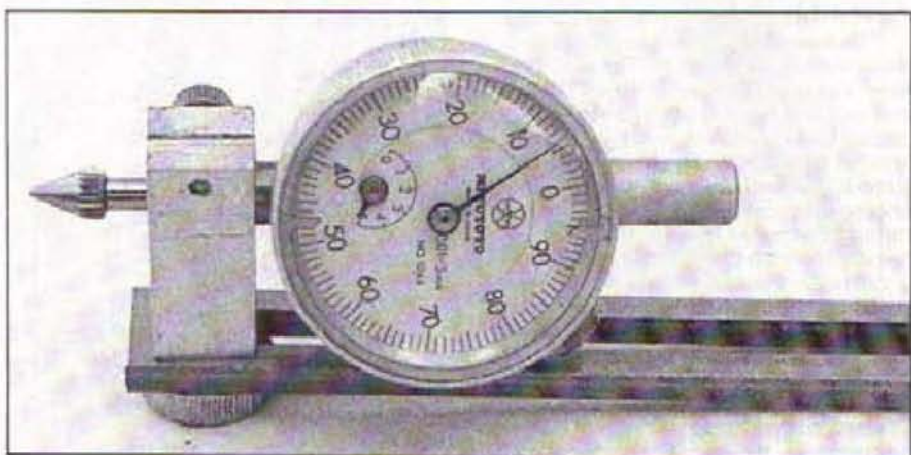
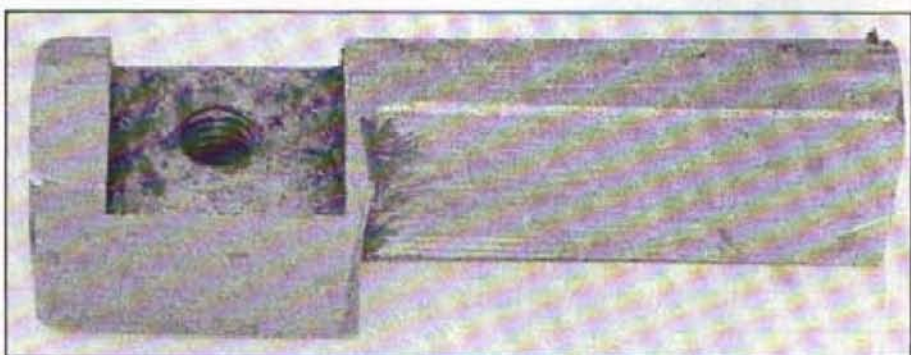
We sometimes need to get a very high degree of accuracy which the dials cannot possibly give us, a typical example being when machining a piston to fit the cylinder of an internal combustion engine. It is the last few ten thousandths of an inch or hundredths of a millimeter that cause the difficulties and these can be measured easily and accurately with a little thought. Another problem often arises in bringing the tool to exactly the same spot each time. It is true that stops can assist here, but how accurate are they really? Even if made to fine limits, a tiny piece of dust between the two mating parts can lead to the finished work not being to limits as close as we might wish.

Dial test indicators

The dial test indicator (commonly referred to as a clock gauge) is something that many readers will possess. It's a fairly expensive instrument which fortunately we only need to purchase once in a lifetime. Normally it is the most underused tool in the workshop. It is brought out to set work accurately on the lathe or milling machine and then put carefully away in its box,



Above, a clamp used for holding parts to the lathe saddle. Below, a stop used on the cross slide; a slotted bar fits into the slot in the stop and this prevents it twisting out of line. Bottom, a dial indicator fitted to a slotted section. It is held with a piece of drilled and tapped aluminium; some gauges will only need a nut and bolt to secure them while others will require this treatment.



possibly even wrapped in cotton wool. This is a shocking waste when we think how much the instrument costs, and how little use it will get even in a lifetime of work.

What is being suggested here is that the clock gauge should be made to work for its living!

The gauge shown in this article is one of



A series of different types of knurled screw, used for securing the attachments.

gauge to be set in some quite awkward places and so has advantages in some situations.

The method

Basically, what we are going to do is fit the gauge to the moving section of the machine, and a plate or pad on a fixed section. The gauge is run up against the pad and the reading is taken direct from the clock. It soon becomes obvious that by doing this, a very high degree of accuracy can be achieved. There is no need to make fine adjustments to stops as we can adjust the dial on the gauge to give the required readings. If using an Imperial machine and a metric gauge then automatically the last little bit is measured in metric form, and the reverse applies to using an Imperial gauge on a metric machine.

Fixings

Readers must devise their own fixings for the particular lathe they are to use, but this is not difficult and suggestions will be made to assist in so doing. The type of fixings required, whatever the lathe, will basically be the same.

They include slotted mild steel section brackets milled to fit particular parts of the machine, some large-headed knurled bolts, and knurled nuts that will allow quick and

screw holes that are part of the general lathe set-up. Although the photographs were taken on a Myford ML7 lathe the tapped holes were not used, in order to demonstrate to readers how the idea will work on any lathe.

The cross slide

For cross slide work we need to put one part on the slide and the other on the saddle. The set-up shown has the clock gauge fitted to the cross slide via an odd-shaped tee bolt. This left plenty of room for adjustment. The fixed pad is on a bracket attached to the saddle, and can be adjusted via the slots. There is no reason why the clock gauge should not be fitted to the saddle and allowed to come into contact with the cross slide; the system would work just as well and only one fixing would be needed. It is certainly the way to do it if using the system on a compact lathe, as a lot of space is saved.

The saddle

Measuring the travel of the saddle, the gauge can be bolted with a bracket to the saddle and either made to contact a pad connected to the bed under the headstock with another bracket, or to actually strike the headstock. The latter idea is probably not as accurate as using a properly made pad. Again the thing can be done in reverse, with the clock gauge on the bed of the lathe set to strike the saddle. This idea has advantages for owners of Myfords, as there are a number of tapped holes available to fix the gauge in position.

The vertical slide

The idea is particularly useful when using the vertical slide, as accuracy is often somewhat doubtful. The gauge can be fixed with a tee bolt similar to that shown for the cross slide, and a pad bracketed to the cross slide to get the measurement.

The milling machine

Using dial test indicators in this way on the milling machine is an excellent idea. Fixing to the moving table and the static machine is not at all difficult. Locking screws and gib adjusting screws suitably adapted are ideal fixing points, and again,

Continued on page 77



An attachment - in this case a dial indicator - fitted to the lathe cross slide.

a cheap range marketed by Messrs Proops Distributors. Unfortunately, they no longer have any available so readers will not be able to use this type, which in fact had no fixing lug, as do most. This is no bar to using the methods shown however, as any clock gauge can be used, but the smaller ones are best. Where it is not convenient to use the bolting lugs then the fixing shown in the photographs will do. It allows the

easy tightening of the brackets and slotted strip.

The strip used needs to be reasonably substantial and those shown are of $\frac{1}{2}$ in. by $\frac{1}{4}$ in. bright mild steel. Black steel would do equally well. The brackets are made from 1 in. by $\frac{1}{2}$ in. mild steel bar, the fixing holes being drilled and tapped 2 BA or thereabouts. Owners of Myford lathes will be able to make use of some of the odd

QUICK TIP

Allan Mackintosh writes to us from Cornwall: "Occasionally it is necessary to make two or more identical plates. The obvious solution is to mount them vertically in the milling vice and mill the sides together. It may then be necessary to drill identical holes. The plates are then mounted horizontally in the vice one on top of the other; unless the vice is brand new and in A1 condition, the bottom plate is tight while the top one is not properly gripped."

"I keep in my workshop a roll of aluminium roofing flashing; this is soft aluminium twelve inches wide and 0.23 in. thick. My roll is, or was, twenty five feet long. When faced with the above problem, I cut a couple of strips from the roll and line the vice jaws with them. Lo and behold, a tight grip on both or all the plates being drilled! An alternative could be lead flashing but this would be considerably more expensive."

ELIMINATING BACKLASH

The cheap milling machines from the Far East represent remarkably good value for money and, with careful use, will give long and faithful service. They do, however, have some slight faults, and, whilst these faults in no way prevent them working well and accurately, a few modifications can make them even better. G. G. Tardrew from Johannesburg has tackled one problem and has sent the solution for the benefit of readers. Matters can be put right without too much difficulty but, as he says, accuracy is essential in doing so. Whilst in his article he describes the use of a dividing head and a large slotting tool for making the bronze bush, it could almost certainly be done with the use of a change wheel dividing system and a much smaller keyway cutter such as the one described in the last issue.

A vertical milling machine which I purchased from a local dealer handling Taiwanese small tools, gave satisfactory results when used for end-milling and boring, but I found that excessive play in the spindle drive caused the 3 inch facing head or a fly-cutter, used on surfacing, to set up a most annoying 'hammering'. This, I feared, could be detrimental to the carbide tips in the head and unkind to the machine in general.

Naturally, the finish from machining under such conditions left much to be desired. This action was more pronounced when machining a strip less in width than the spacing of the cutter tips and also in fly-cutting, so I decided the amount of backlash should be investigated. To do this, it was necessary to prevent rotation of the internal splined part by wedging the head pulley which is keyed to the quill against the lower part of the guard casing. I set up a Dial Test Indicator against one of the cutters, and in applying hand movement a reading of 0.28 mm (0.011 in) was noted. There could be no doubt of excessive clearance in the splines and I would have liked to assess the amount of such by actual measurement, but it would have

entailed stripping down the complete assembly of the quill – an avoidable task if not absolutely essential.

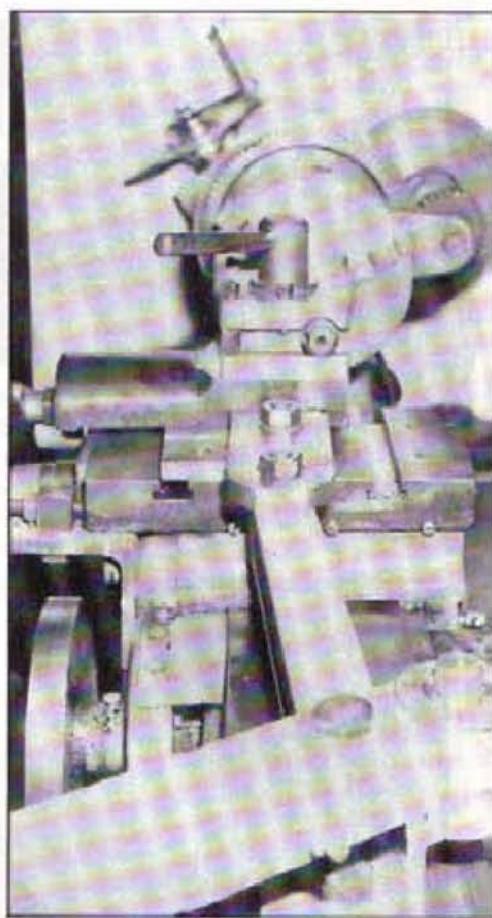
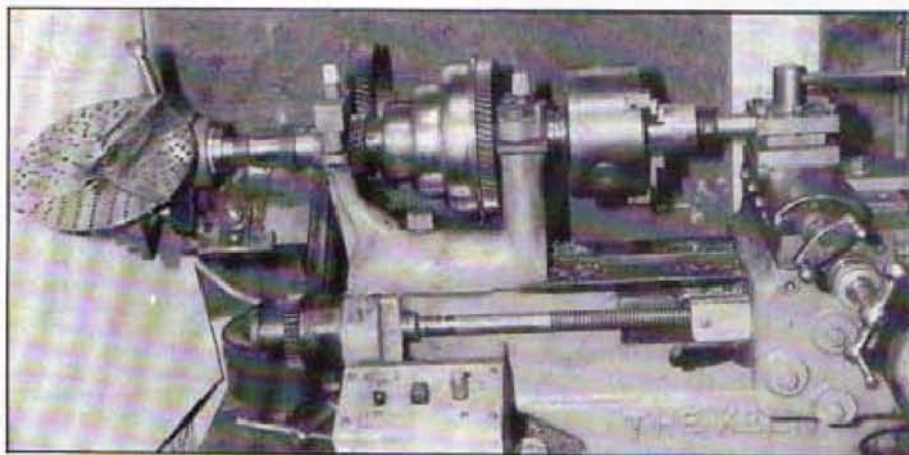
However, seeing that the pitch diameter of the splines was ± 1 in, I inferred that the clearance could be $\frac{1}{3}$ of the travel at the 3 in. diameter, ie $\frac{0.28}{3} = 0.093$ mm (0.0036 in.).

This would not pass inspection on any machine used in industry; but, I suppose, to have the sliding quill as a facility for incidental drilling, there must be a measure of free sliding to the spring-return and also to allow a 'feel' in operating with the hand lever.

The original conclusion

In the normal milling mode, the quill is clamped at top stroke, so in a sense, the spline drive is not of any purpose, as the pulley could just as well be keyed solidly to the spindle, giving a direct coupling. A thought came to me about doing just that and forgetting the drilling feature. I soon dispelled this idea as being nonsensical and then noting that the splined spindle projected 30 mm above the pulley boss when at the top position, it occurred to me that this extension could possibly be

View showing the dividing head coupled to the lathe mandrel and bolted to an angle plate. Cutter-bar is clamped in the tool post referred to in the text.



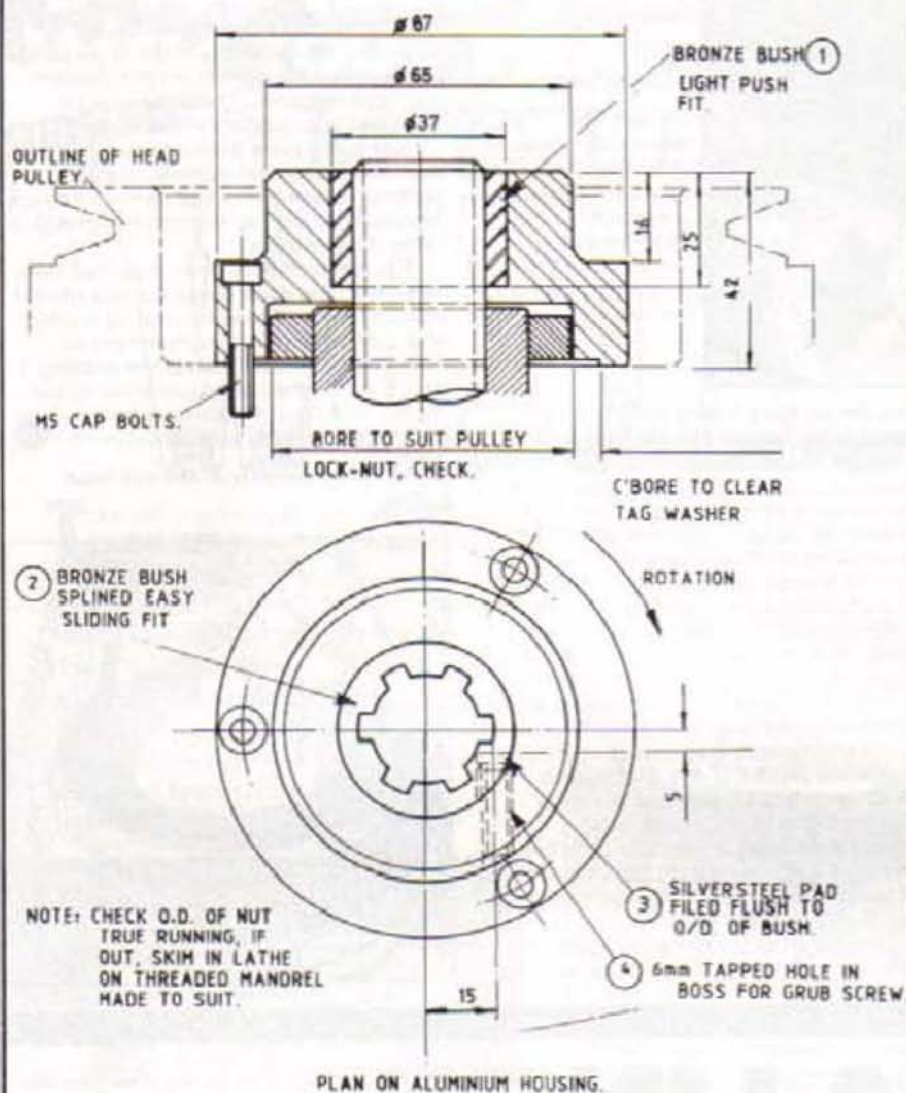
The slotting attachment set-up complete; the hand lever is 24 inches in length.

gripped and fixed rigidly to the pulley in some way, leaving a means by which to release it for drilling.

The sketch Fig. 1 shows how this was achieved, but since the initial arrangement, a simple modification has been introduced, particulars of which are incorporated and marked up. For the sake of interest, I will explain the steps first taken. The idea was to have the bronze bush in the housing, a tight fit and the bore a light press fit for the splines. The boss as detailed with the bush in place, I entered on to the protruding spindle and using a draw bolt, it was a simple matter to pull the assembly down on to the pulley, bolting it with three M5 Allen cap screws to the web. A solid connection resulted with no play; the intention was to remove the housing when requiring the quill feed – somewhat cumbersome, but workable. This ruse put an end to the hammering, but alas, in time the bronze splines became worn and we were back to square one. I did not fancy making a new bush to restore the grip, hence the modification referred to above.

Updating the idea

In the new arrangement, the bush is rotatable (only slightly) so that play can be avoided by forcing the driving faces of the splines to stay in contact, and this is effected through a grub screw applied tangentially to a step cut on the outer diameter of the bush. The centre line for drilling the tapping hole was carefully laid out, so that the major thread diameter would emerge, just touching the housing bore. This operation was carried out with the bush in place and, being a tight fit, it could not move. The drill was run down to



radially, but without any tendency of upsetting concentricity. Slacking off to use the quill feed takes a minute or so and, conversely, locking is equally convenient. I have a feeling that, on first thoughts, some people will vow that the drive from the pulley to the spindle is totally via the bronze bush. This I can assure you is definitely not the case, because what happens when the bush is adjusted is that the spindle splines are forced against the driving faces of the pulley splines, hence no backlash. Following the direction of rotation arrow on my sketch will clarify this point.

Construction

Making the boss was a straightforward turning job with emphasis on keeping all the machining concentric and square to the centre line. Aluminium was chosen partly on account of availability, but also for lightness, in keeping with the pulley. The splined bronze bush presented quite a challenge considering the accuracy which I felt was required and at the time the only means to carry out the task meant using my old lathe. Reverting back to what I have already said, it was important to have the splines a very neat fit and it worried me as to whether I could execute the spacing sufficiently uniform to satisfy this condition.

I did some pondering and convinced myself that the dividing head should be coupled directly to the rear end of the head stock mandrel, thus precluding any idea of trying to index from a change-gear wheel, using a dedent pin for picking up the six spacings. The dividing head had never been set up like this previously, and a bit of adapting had to be carried out to provide a coupling on to the lathe and the body of the dividing head firmly fixed. I was able to

Left, all dimensions are metric on this construction drawing. Below, the splining operation completed after roughing out.



the specified depth, penetrating the bronze slightly to initiate the step. The bush was then pressed out and reset on an angle plate to the scribed centre line which had been marked on at the time of laying out. It was a simple matter to pick up the location of the 5mm tapping drill where it had run into the side of the bush and then to plunge-cut with an 8mm slot drill, forming a flat seating as shown.

A slot drill is well suited for such a purpose, as no pip is left in the centre. At this stage, I eased the outside diameter of the bush to a light push fit in the housing, making it responsive to adjustment of the grub screw. The tangentially drilled hole in the boss (5mm) was tapped out to take a 6mm grub screw and I took particular care to run the thread well up to the centre line. Finally, I parted a disc 2.5 mm thick from 8 mm dia. silver steel and secured it in place with Loctite at the step cut in the bush. This I felt would prevent wear of the bronze from the screw.

The outcome of this alteration has been most successful, as the drive can now be locked as if a set screw were applied



At left, the aluminium boss or housing; note the grub screw fully extended in the bore and the bronze bush showing step-cut on o/d.

bolt an angle plate to the gear quadrant which provided a stable support, making alignment a simple matter.

The next consideration was the slotting mechanism, which would have to be robust; so for guidance, I turned back the pages of *Model Engineer* to consider if any of the self-contained attachments which have been featured could be used. None of these, however, seemed to offer any advantage over simply using the saddle as a sliding bar carrier, operated by a hand lever. Many a bore must have been keywayed by this means, but I suppose objections could be raised at a practice liable to wear the slide-ways. Well, perhaps with an old lathe one is not quite so particular and I say "keep the lubrication flowing"!

The cutter bar I used was $\frac{1}{2}$ in. diameter being the maximum size for the 22mm bore and it was firmly clamped in the tool post which is fully described and detailed in *Model Engineer* of 6th February 1981.

This device has a boring bar station line-bored to the lathe centre line and thus holds the bar at the exact height as required. The roughing and finishing bits were ground from $\frac{1}{2}$ in. square tool steel, making the roughing-out one about half the finished width and central to the shank in order to leave an equal amount of metal on each side for the finishing bit to remove.

The bronze blank was bored a firm sliding fit to the root of the spline with the object of ensuring true running when the landings fit together, but I decided to allow ample clearance over the tips of the teeth. In proceeding with roughing-out the flutes, I made the depth 0.12 mm (0.005 in.) in excess and then set a stop to the cross slide for the sake of uniform depth, obviating the need to measure each flute. This operation, considering the time spent on preparation, went rapidly and so did the final sizing.

I must say the particular care taken in indexing was worthwhile and the resulting

fit of the splines attributable to this. Originally, the closeness of the fit prevented backlash and for a time I felt the problem had been overcome, but it can now be assumed that, in addition to the wear caused by frequent dismantling, the bronze bush must also have suffered as the fit became slacker. I think that as the clearance increased, so did the 'hammering' and thus faster deterioration.

The simple modification described here was made and since it was put into effect, I have used it for two years with no trouble and with an all-round improvement on finish, even from endmills when profiling. I trust this idea may be of use to owners of the mill/drill type of machine, who may be experiencing the same problem.

Below, final assembly on the mill head pulley.



SCRIBE A LINE

The corner of MEW that's reserved for your letters and enquiries; here are just a couple to get the ball rolling - there's plenty of time for you to write in with your comments and questions for the next issue!

A large number of readers have requested information on where to get materials; in particular, large section metal and various plastics.

Whilst, generally speaking, the model engineering suppliers do a good job and stock most of the metal we need, it is just not possible for them to stock everything. They must order metal in bulk, cut it to the lengths in which it is to be sold and then stock it until it actually is sold. This is expensive both in terms of stock held and space. They naturally, therefore, tend to stock the popular sizes. When it comes to large sections, be it flat or round, we must in general look elsewhere. Some of the stockists do carry pieces of large section metal in the form of off cuts, but, for obvious reasons, cannot put it in their catalogue and so it is only available to callers.

By and large, such metal can be obtained from a good metal stockist. These firms are to be found in the Yellow Pages and most towns of any size will have one or two. These days they are almost invariably situated on industrial estates. They are unlikely to be interested in supplying small

section material except in very long lengths, although usually if a long piece is purchased they will gladly reduce it to manageable lengths. However, generally speaking, this sort of material is best bought through a model engineering supplier. When it comes to the larger sections of metal, however, the stockist will usually supply exactly the length ordered. The reason is fairly simple - the firms they normally supply will also often want short lengths of such material.

The only way to find out is to telephone and enquire. Try several firms if need be. Of course, they will not offer a mail order service, and cannot be expected to do so, but some have been known to drop the metal off when a lorry is in the customer's area. All we can say is that, on average, getting hold of large metal is not as difficult as it seems if one is willing to make a few enquiries.

A similar situation applies with plastics. Most model engineers' suppliers stock some but, again, they have to limit the quantity held. College Engineering Supplies seem to stock a larger range than most, possibly because their main business is

with the colleges. Plastics suppliers are also listed in the Yellow Pages and they usually carry quite large stocks of all sorts of material. They sometimes will cut to size but not always - it depends largely on the type of firm contacted. Most are not only stockists but fabricators in the material as well and this is the governing factor. Many have scrap boxes of material which they will let customers look through and buy from. Because it is in a scrap box rarely seems to mean that it will be bought at scrap prices but at least it is a means of getting the plastic which is required!

Specialist screws

Mr Simmons of Coventry has written and asked for details of the screws used in watches, particularly old ones.

It is not possible to give a full answer to the question, as to do so would take several pages of the magazine. Popular at one time were standards by Bourgeois; there were twenty six sizes covering numbers 00 to 24. Another standard was by Latard with a range of twenty one threads varying from 2.25mm down to 0.3mm. More modern is the Progress standard which seems to be the more logical one with sizes in increments of 0.1mm. Even more recently, some manufacturers have used small BA or metric threads.

Watch threads are usually made with thread plates and at one time these were made by Stubbs, amongst others. Whether they still make them we cannot say. Perhaps one of our readers can enlighten us further on this somewhat obscure subject.

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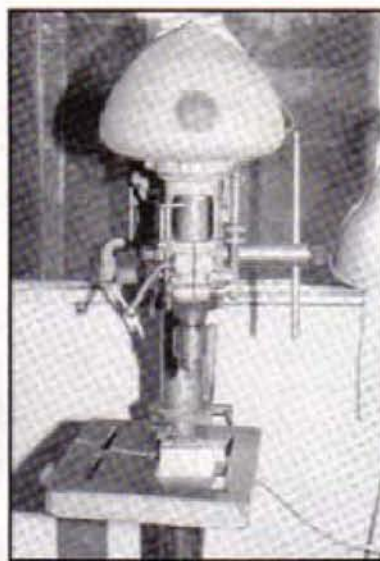
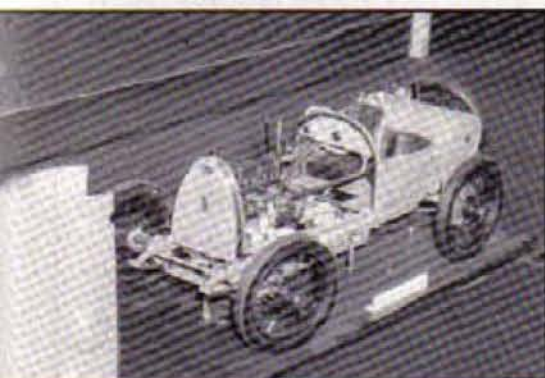
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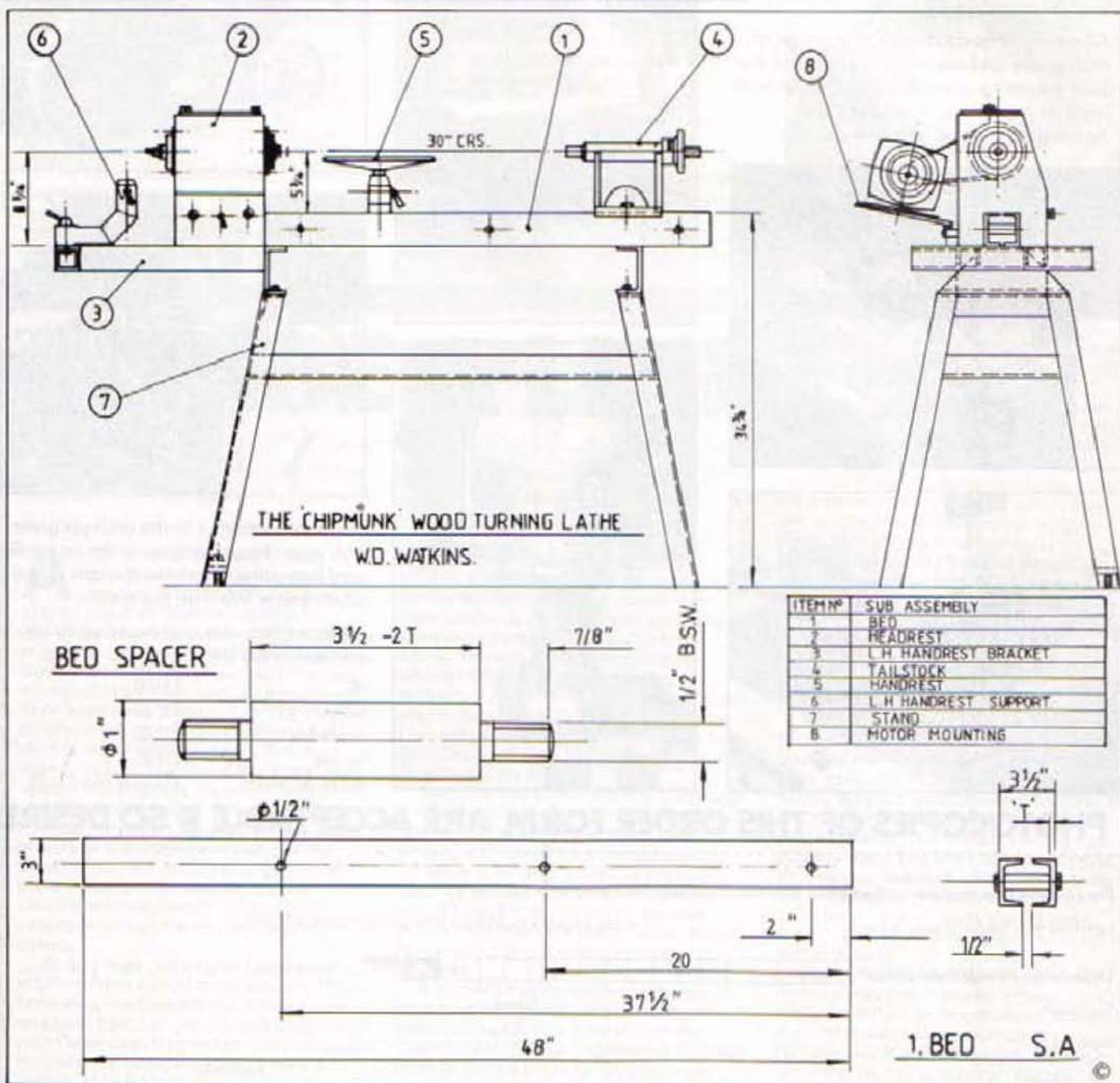
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MAKE THE 'CHIPMUNK' WOOD-TURNING LATHE

This lathe, named by the author Dyson Watkins 'The chipmunk', is a robust woodturning lathe of reasonable proportions which is ideal for the home workshop. Some welding is involved in the construction but brazing could be used as an alternative. There are no castings required; although the photographs show a cast tailstock, the author has designed a fabricated one for the benefit of readers who might find it difficult to get a casting. Readers who indulge in miniaturisation might like to reduce the measurements and make the machine to suitable dimensions for their particular interest.

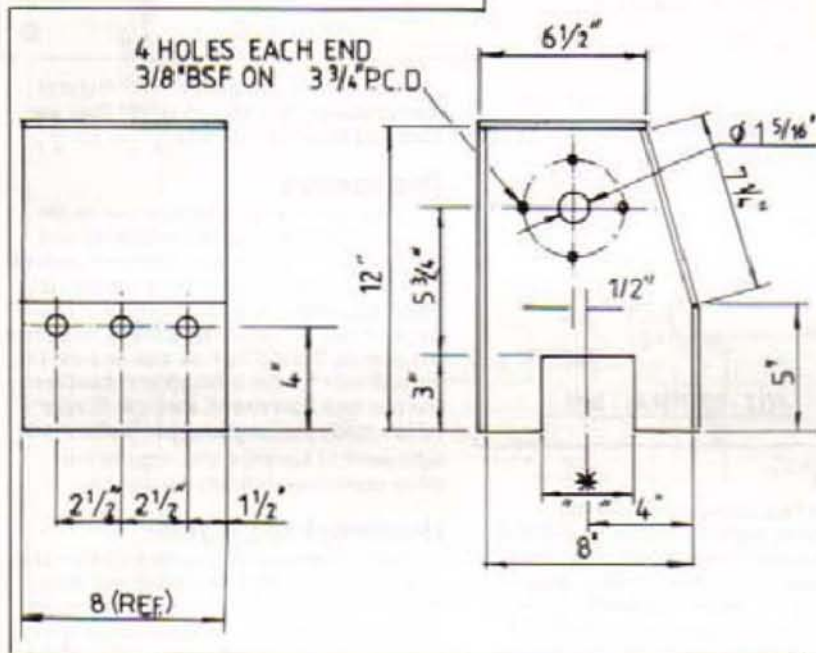
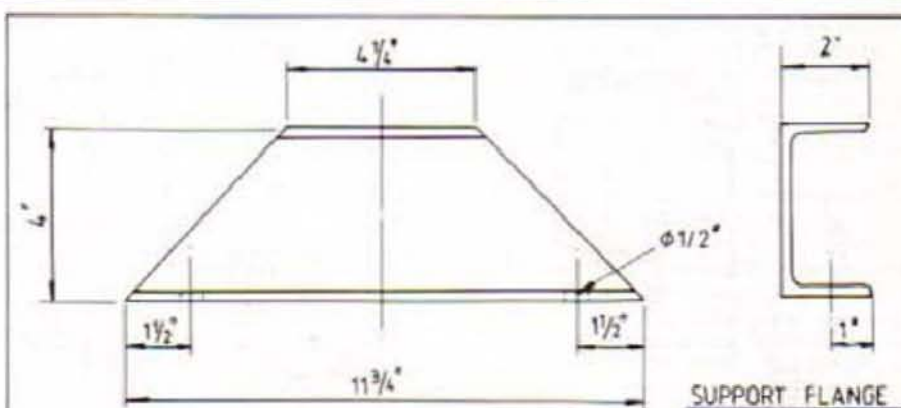
My decision to build a woodturning lathe came after several years of watching the advertisements for a suitable second-hand machine of reasonable quality at a suitable price. Machines tended to be either too flimsy, or, if suitable, too expensive. A desirable machine would cost an arm and at least one leg! My aim, therefore, was to undertake the design and construction of a lathe with a specification equalling those available commercially at prices of over £600, and by using basic workshop facilities of a centre lathe, drill and an electric welder. The photograph shows a tailstock made using an aluminium casting, but because the majority of constructors lack casting facilities, I have substituted a fabricated design for this item. This has a hollow spindle useful for drilling long holes with an auger.

The machine is made from structural mild steel sections, all of which are readily available. Some of the building methods used, may be a little unusual, but are, nonetheless, effective. Maximum distance between centres is 30 in. with 11½ in. swing.

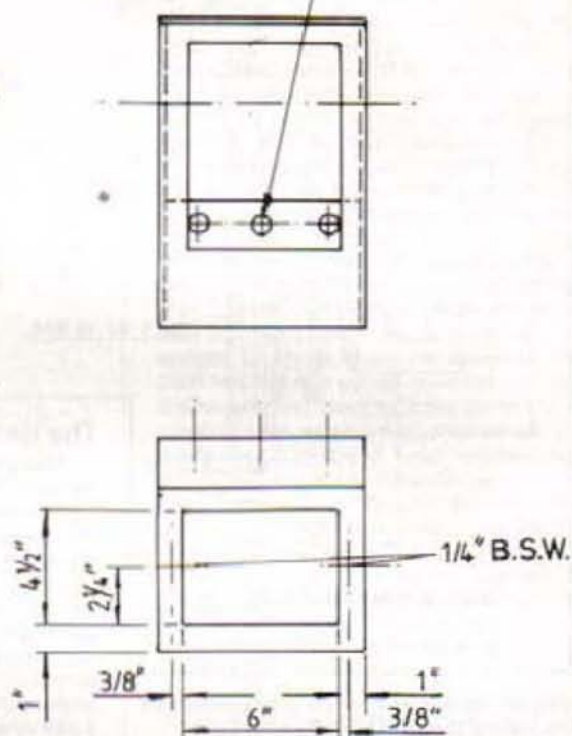


over the bed. At the bowl turning end the swing is 17 in. The machine is furnished with both forward and reverse. The headstock is a welded fabrication of rigid construction providing a vibration-free operation which is essential for a good finish. One leg is furnished with a levelling adjuster which caters for any condition of floor. Four spindle speeds are available although there is ample space to provide another range if required.

Material is best obtained cut to size if it is possible. Many stockists operate a guillotining service which will help to avoid much backbreaking work with a hacksaw and file. Check the material before purchase to ensure that the channel used for the bed is free from any twist or wind.

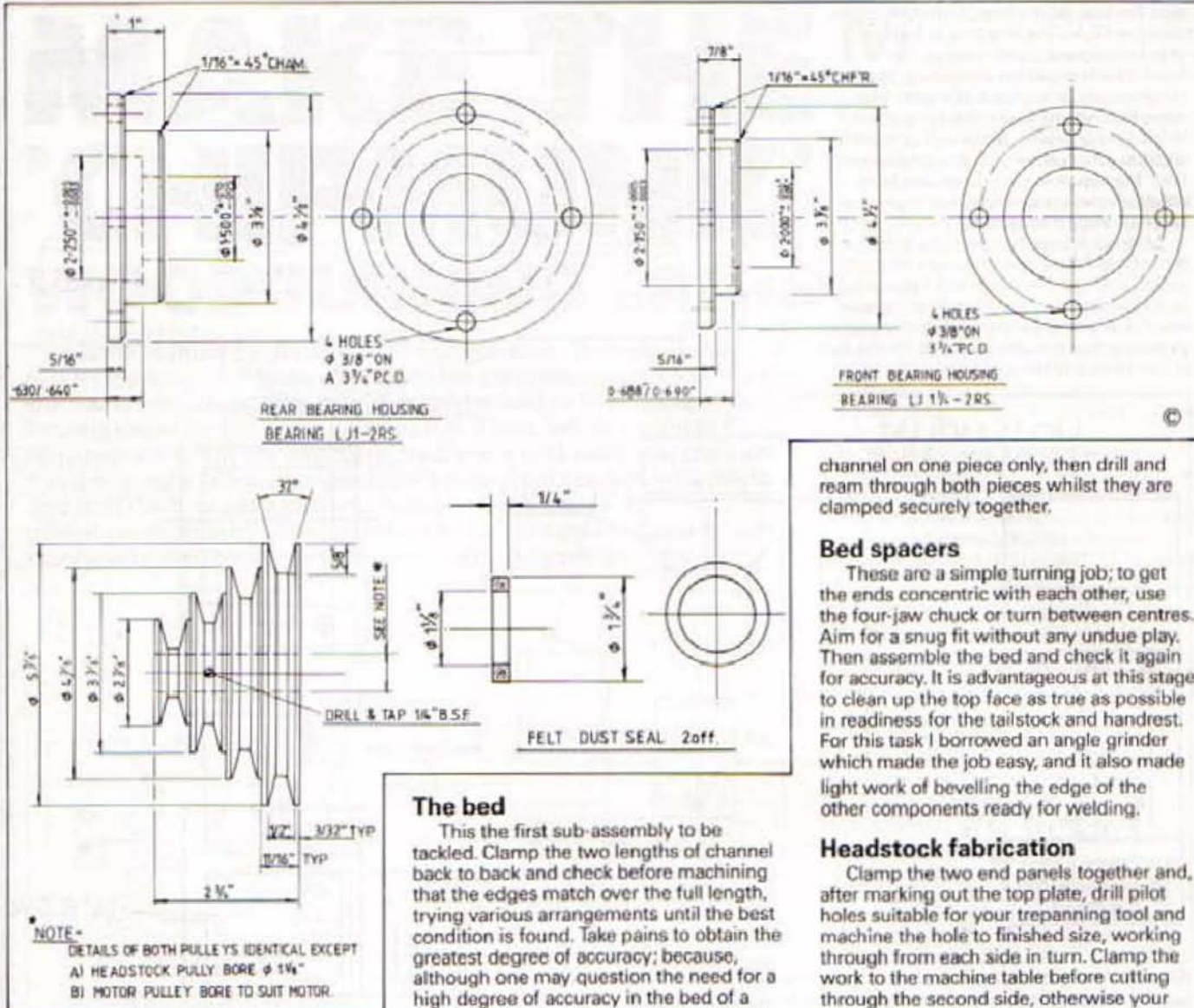


SIZES TO SUIT SWITCHES.



Below left, the completed lathe on the stand and with accessory tray below. Although the author has had the tailstock cast for the prototype, the article gives details of a fabricated alternative. Below right, illustration shows construction of the bed with the spacers which allow adjustment of the tool rest, tailstock, etc. Simple form of construction means that welding is kept to a minimum – indeed, with a little planning, the lathe could be made without the use of a welder.





Below, view of the motor and headstock including the tool rest. Below right, close-up of the motor arrangement looking down on the bed and also showing the adjustment of the tool rest.

The bed

This is the first sub-assembly to be tackled. Clamp the two lengths of channel back to back and check before machining that the edges match over the full length, trying various arrangements until the best condition is found. Take pains to obtain the greatest degree of accuracy; because, although one may question the need for a high degree of accuracy in the bed of a woodturning lathe, it will be appreciated when drilling holes using the tailstock that a drill which does not enter the work on centre will wander about producing an oversize hole, as well as not following the true centre of the work. Next, mark out the

channel on one piece only, then drill and ream through both pieces whilst they are clamped securely together.

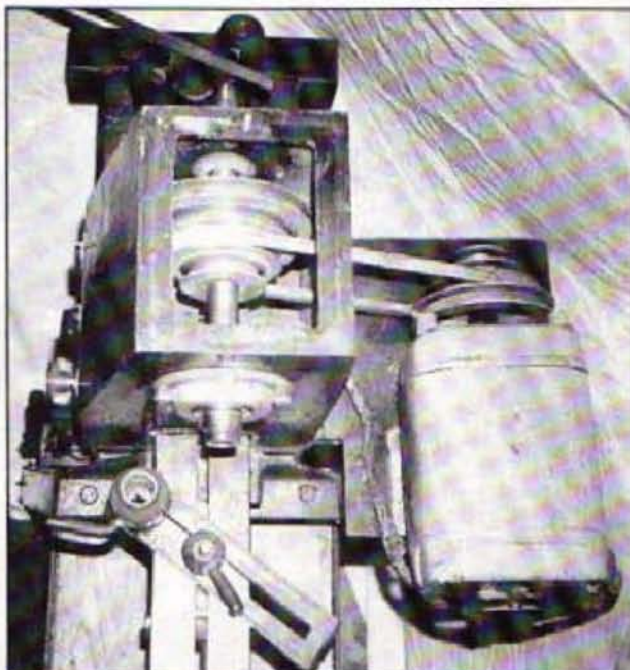
Bed spacers

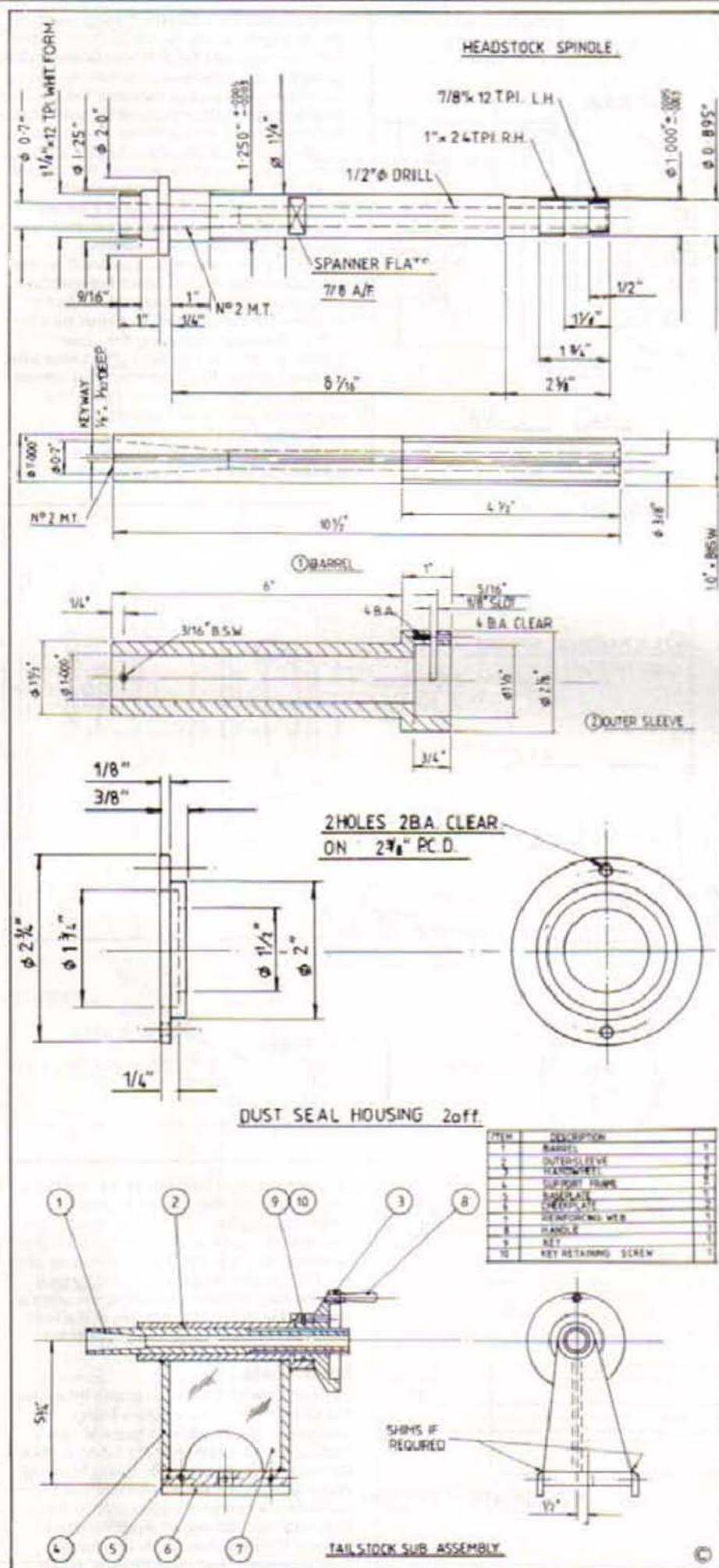
These are a simple turning job; to get the ends concentric with each other, use the four-jaw chuck or turn between centres. Aim for a snug fit without any undue play. Then assemble the bed and check it again for accuracy. It is advantageous at this stage to clean up the top face as true as possible in readiness for the tailstock and handrest. For this task I borrowed an angle grinder which made the job easy, and it also made light work of bevelling the edge of the other components ready for welding.

Headstock fabrication

Clamp the two end panels together and, after marking out the top plate, drill pilot holes suitable for your trepanning tool and machine the hole to finished size, working through from each side in turn. Clamp the work to the machine table before cutting through the second side, otherwise your work may go into orbit!

Next, cut out the slot which straddles the bed using the width of the assembled bed to work to. A good fit here will greatly help in the alignment of the headstock spindle later.





The next stage requires three short lengths of tube of about 2 in. diameter, the ends of which must be turned square with their axis. The sum of their finished lengths must be equal to the inside dimension measured between the end panels of the headstock.

The panels are now reassembled using a long bolt or stud to hold the panels together, but this time with the tubes in between. Resist at all cost any temptation to use just one tube as a spacer. Consider the effect on your blood pressure when attempting to remove it after welding up the assembly. The whole idea of using the tubes is to ensure that the outer faces of the panels remain parallel after welding, as the bearing housings eventually bolt on to them.

Switch arrangement

The holes for the switches need to be machined before welding on the front panel. Make certain that the switches you have obtained will allow assembly from behind the panel, because the bed takes up a good deal of the available space inside the headstock, which can make wiring a little tricky. Move the switches up a little if desired, but not too much in case they foul the pulley.

When assembling the headstock for welding, misalignment can be avoided by standing the clamped assembly in place over the bed where it will be eventually welded. Quite obviously, the access holes in both top and rear panels must be cut out before welding. Next, tack the assembly carefully with small welds, after which, if satisfied that all is well, finish welding the whole sub-assembly, balancing weld sequences in order to avoid distortion. The final result should have continuous welds around the outside, with heavy stitch welds around the inside. Remove the stud, knock out the centre tube after which the others will fall out.

Bearing Housings

First turn the outside, leaving out the bores. Then, reverse the work and drill out as much waste as possible. Bore to give a transitional fit with the respective bearing. The fit must be perfect. Machine the end face on the same chucking to ensure squareness. Bore the clearance hole for the spindle.

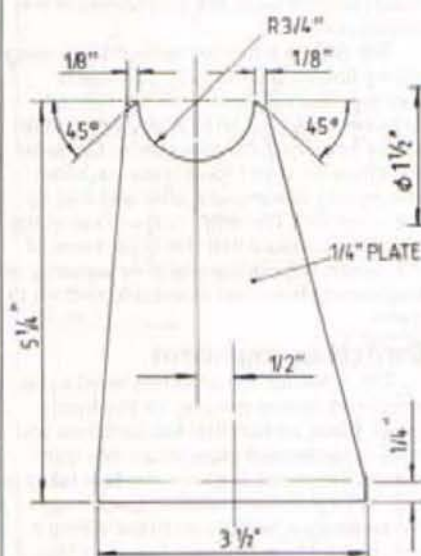
The four bolt holes can now be drilled, allowing generous clearance on one housing to aid with bearing alignment on assembly. Drill two extra holes on the P.C.D. of the outer diameter of the bearing, to facilitate bearing removal when necessary.

The spindle

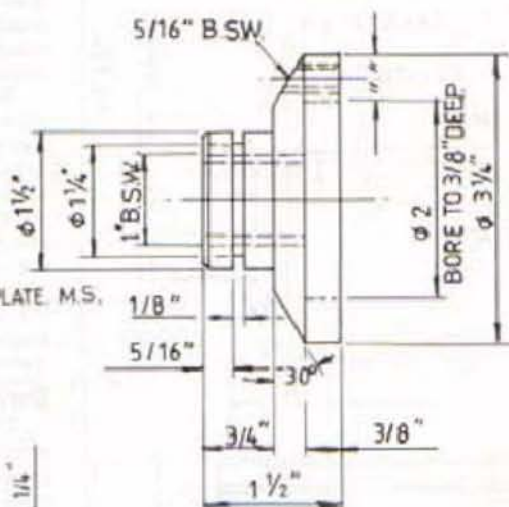
Use a length of good quality bright mild steel, or even carbon steel, for this component. Machining this item on a Myford will involve the use of a fixed steady because of the limited size of the spindle bore. Hold one end in the chuck and the other in the steady. Face each end and drill halfway through from each end until the holes meet. If you do not happen to have an extra long series drill, extend a standard twist drill by silver soldering a length of rod onto its shank. To do this, turn down a short length of the drill shank to about two thirds of its diameter to fit a hole drilled in the end of the rod. The two are then silver soldered true with each other.

In use, withdraw the drill frequently because the swarf cannot escape in the

④ SUPPORT FLANGE



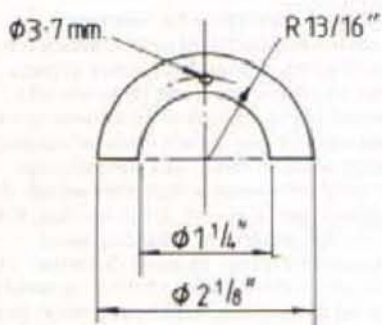
③ HANDWHEEL



ROUND OFF ALL EDGES.

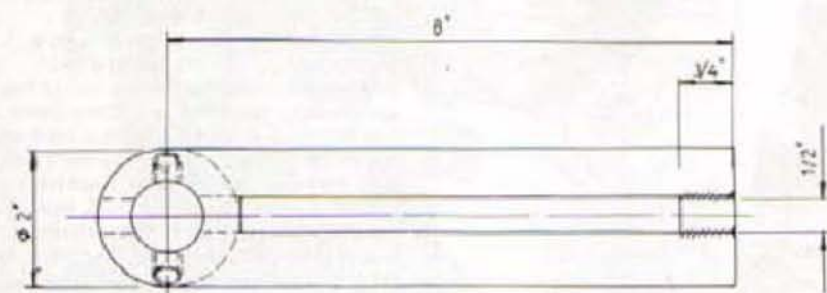
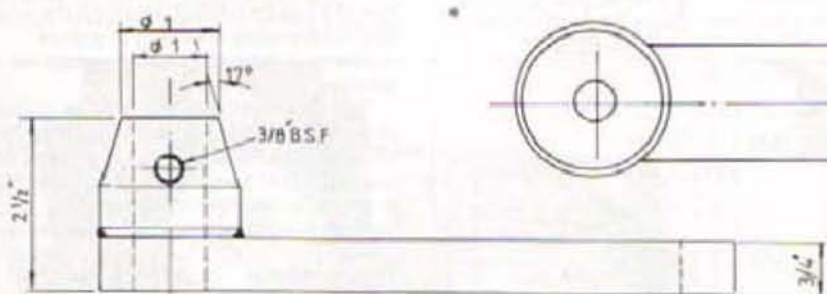
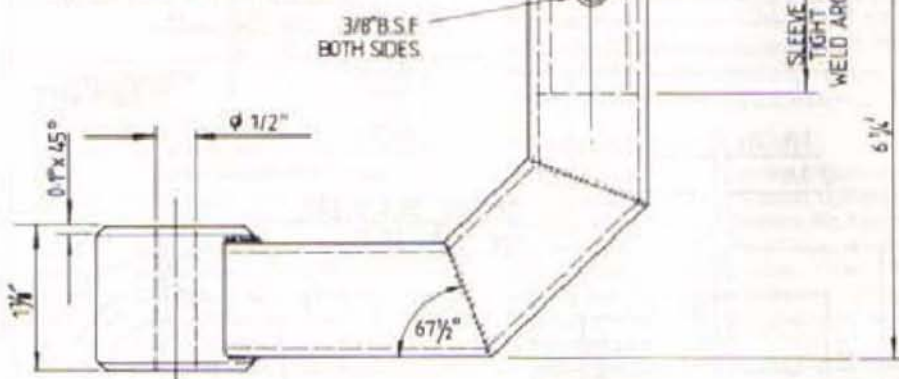
normal way. Still using the steady, machine the 60 degree angle for the tailstock centre. Drill and ream the No. 2 Morse Taper socket or bore it out, whichever method is convenient to you, and machine the 60 degree angle in the mouth of the socket, thus preserving concentricity. Take a light cut along the outside of the bar for a few inches, just enough to clean up the bar and produce a surface concentric with the Morse Taper socket. Remove the steady, grip the bar on the cleaned up diameter using the four-jaw chuck, centred accurately, the other end supported on the tailstock centre. Rough down the spindle to a little over 1.25 in. diameter as far as the 2 in. diameter flange position. Finish turn the 1.25 in. diameter observing the close tolerance, followed by the 1.125 in. diameter, followed by the 1 in. diameter. Next comes the 0.895 in. diameter which forms the register for the Myford faceplate.

The next task is to screw cut the two threads, not forgetting that one is left-handed. Do not try using the same



⑨ KEY - 1/8 BMS.

⑥ L.H. HANDREST SUPPORT



HANDREST SUPPORT.

screwcutting tool for both as the clearance will be different. Reverse in the chuck before cutting the 1.125 in. $\times$ 12 threads per inch thread, check with a dial test indicator as previously, turn the 1.25 in. diameter and the 1.125 in. diameter and cut the thread. Mill the two spanner flats using the vertical slide, or file them; alternatively drill a hole for a tommy bar, chamfering both sides.

Dust seals

These are simply felt washers fitted over the spindle, their outer edges being clamped to the inside and faces of the headstock. Take care that the fixing screws do not foul the bearings by being too long. Wet the felt with oil on assembly, later.

Weld the headstock assembly to the bed, and weld on the left-hand handrest bracket. Construction of the bracket is straightforward, and no additional details

are given, but be sure to use tube with a heavy wall thickness.

Screw collar and locknut

Screwcut a length which is long enough to make both items, and part them off to keep their end faces square. Drill holes for a 'C' spanner.

Motor table support

Lugs need to be made and welded on to the back of the headstock to support the motor table. Push a length of rod through the holes to preserve alignment during welding. Matching lugs are welded to the motor table using the rod as before. Weld

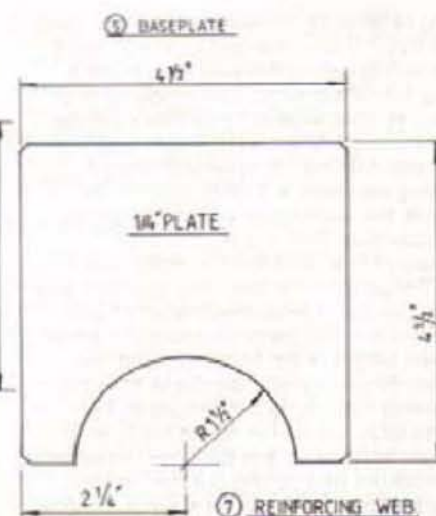
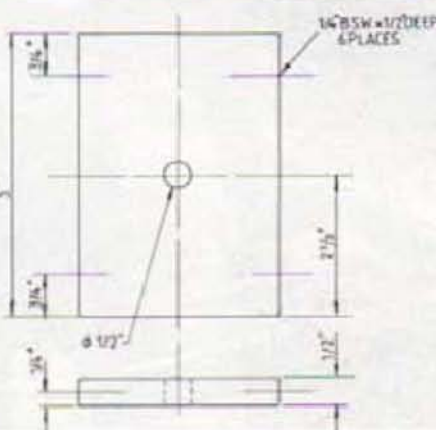
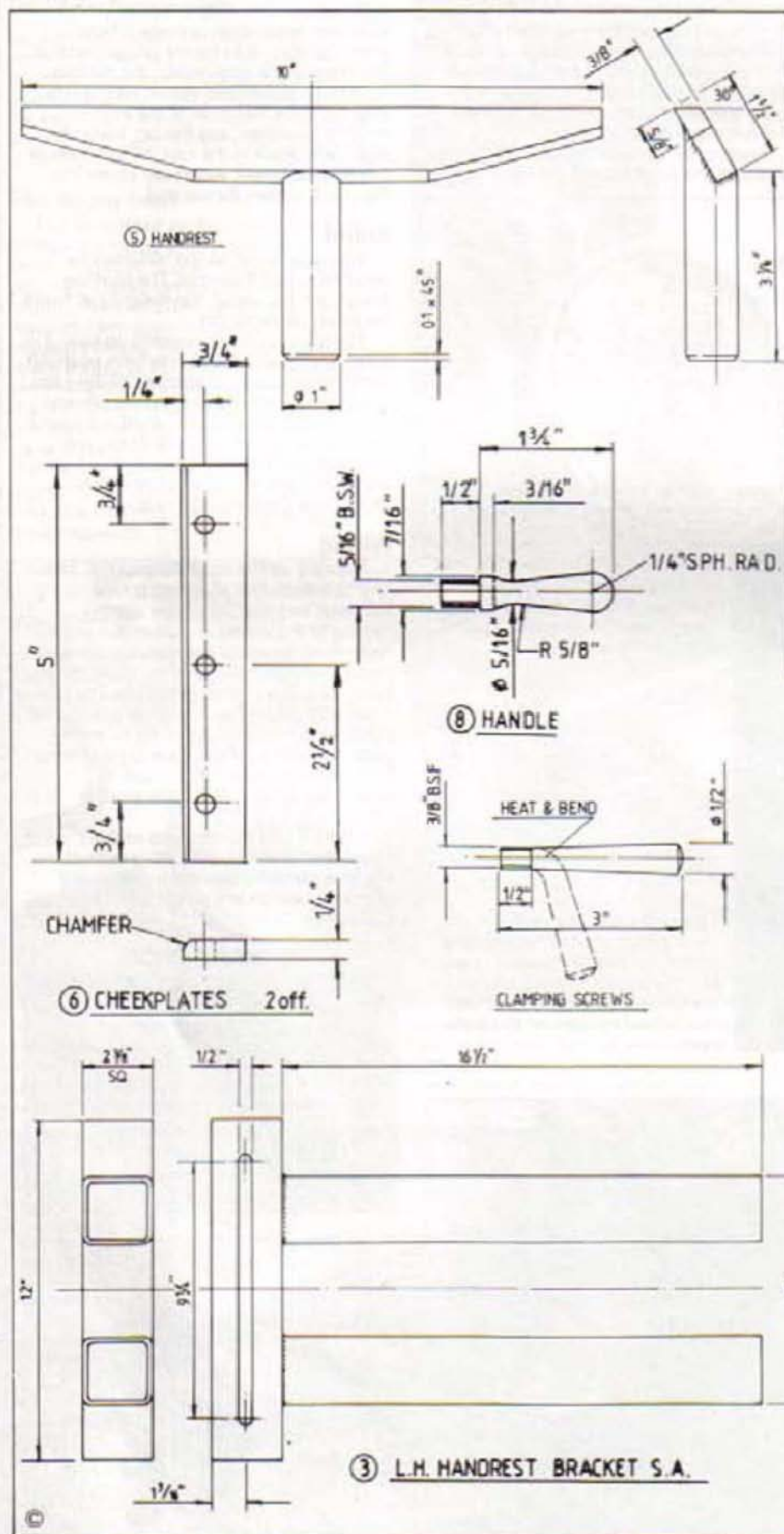
on the triangular channel supports and give the work completed so far a good clean, after which it may be given a coat of primer followed by a finish coat of paint. Avoid painting the areas where the bearings will fit.

Headstock spindle assembly

Fit the bearing into their housings and bolt on the right-hand one. Slide the spindle through, and slide on a dust seal followed by the pulley and drive belt. Next comes the other dust seal and then the other bearing in its housing which should not be bolted on too tightly. The screw collar can be assembled next. A No. 2 Morse Taper test bar is now fitted in the spindle taper. This can be made, and is simply a No. 2 Morse Taper shank with a plain parallel extension 1 in. diameter X6 in. long. Using a dial test indicator on a scribing block standing on the lathe bed, the bearing housings are adjusted until parallel with the bed in both planes. They are then tightened firmly and two dowels are fitted in each housing to prevent further movement. Tighten the screw collar carefully so that there is no end play, avoiding the application of any pre-load to the bearings. Tighten the locknut. Application of a little Loctite to the threads will prevent them loosening. Clamp up the pulley securely.

Tailstock

Machine the barrel first. It is an advantage to have as long a travel as possible consistent with being able to drill the hole down the centre. After the centre



hole has been drilled, support the Morse Taper end on the fixed steady, and the other end in the four-jaw chuck. Clock up carefully and machine the Morse Taper socket and 60 degree angle. Remove the steady and support on the tailstock centre. Screwcut the 1 in. $\times$ 8 threads per inch left-hand thread. Having reversed the barrel and holding the socket end in the chuck the other end on the centre, cut the keyway using the vertical slide.

The outer sleeve is turned next. Drill out as much waste as possible before boring; aim for a good sliding fit. Next, clean up the $\frac{3}{4}$ in. diameter, so that the steady will hold the work concentrically to bore out the $\frac{1}{2}$ in. diameter recess. If the bar is initially 8 in.

the base plate and drill the hole for the clamping bolt. The reinforcing web can then be made. The test bar previously made is used again, this time to align headstock and tailstock. Fit the tapered end into the headstock spindle, and the tailstock outer sleeve is slid on to the 1 in. diameter. The base, furnished with the cheek plates, is positioned beneath and the support flanges and reinforcing web fitted into place. Ideally, the support flanges should slide into position without undue force or slackness. The assembly is now tacked together carefully after which it is finally welded securely.

Next, make the hand wheel and handle. Graduate the outer edge if desired; the

eight threads per inch thread provides a useful pitch. The key is made initially as a complete disc and then cut into two parts. The 3.7mm hole is best marked out in situ. The assembly can now be painted.

Handrest support

This does not require additional information other than to advise you to resist any temptation to make it from anything other than heavy-gauge material. The cross piece upon which the turning tool will be supported should be not less than $\frac{1}{2}$ in. thick. Because of the angle at which it is welded, any flexing, however slight, will result in the tool taking a deeper bite into the wood, which will cause it to dig in still deeper. Be warned.

Stand

This is optional, as the lathe can be benchmounted if desired. The levelling device is most useful, the majority of floors not being perfectly flat.

The stand is simply welded up from 2 in. $\times$ 2 in. angle iron, and details have been left to the constructor's discretion. Scaling can, however, be carried out from the general arrangement drawing. The shelf is a useful addition, either to hold tools or to carry extra weight. A book well worth reading which explains this latter point is Peter Child's *The Craftsman Woodturner*.

Wiring

If wiring up the machine yourself, take care to ensure that all wiring is well insulated and that protection against chafing of the wiring is provided. A plastic cover must be made to prevent accidental contact with bare wires or the backs of the switches when changing speeds. The reverse facility will be found very useful in obtaining a first-class finish on turned work, because that last trace of roughness can best be removed by a touch of glasspaper while running the work in reverse.

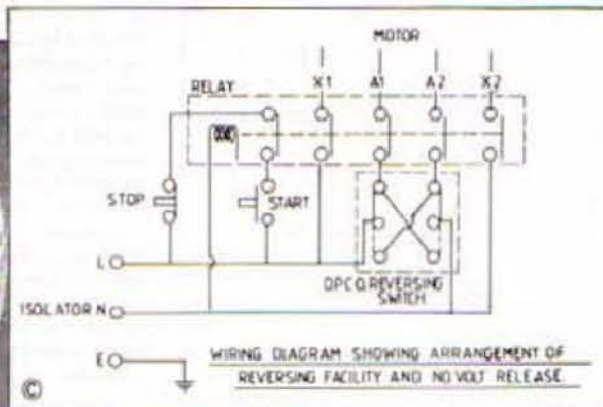
Finally, if you do decide to embark upon this project and take pains to construct the machine carefully, you will be rewarded with a tool which will give many years of pleasure.

SPECIFICATION

Distance between centres 30 in.
Swing over bed 11 in.
Swing at bowl-turning end 17 in.
Four speeds (Forward and reverse).

1. 470 rpm
2. 900 rpm
3. 1530 rpm
4. 2650 rpm

Hollow spindle No. 2 Morse Taper.
No volt release electrics.

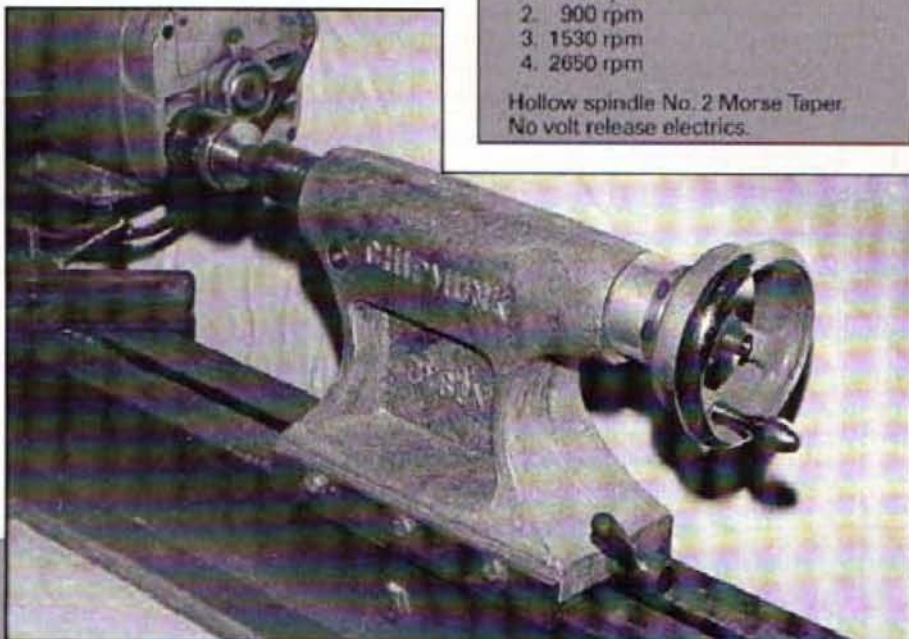


The rear spindle mounting and tool rest, ideal for making wooden bowls, etc., and extending the versatility of the lathe considerably.

The cast tailstock; it is anticipated that most readers will make the fabricated version but the photograph is useful as it shows the holding lever and the bolted section of the lathe bed.

long to allow for chucking at one end, then the 6 in. $\times$ 1 $\frac{1}{2}$ diameter can be machined. If the steady gets in the way, then make a plug furnished with a centre hole to fit in the 1 in. bore, so that the tailstock can be used instead. Machine to length and face the end. Mill the $\frac{1}{2}$ in. wide slot using a slitting saw held in a stub arbor in the chuck, the work being supported on the vertical slide. Drill and tap the 4 BA threaded hole, and the $\frac{3}{4}$ in. BSW hole.

The support flanges must be made as a matched pair. Clamp them together and mark out one of them. Measure the actual centre height of the headstock and the offset dimension and use these sizes for marking out. Clamp the flanges on the cross slide and mill or fly-cut the $\frac{3}{4}$ in. length to clean up and then use the surface as a datum for marking out the $\frac{1}{2}$ in. radius. Much of the waste can be sawn out before machining the radius to size. Next, make



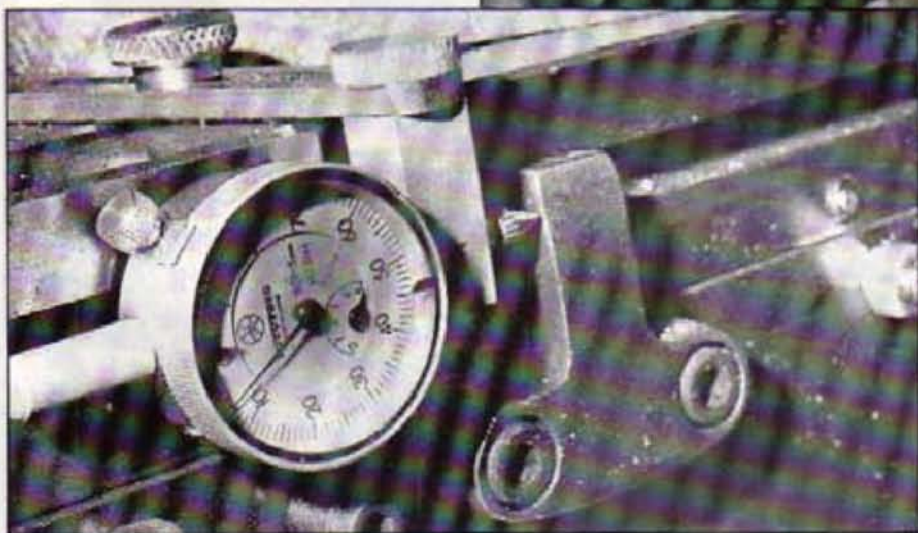
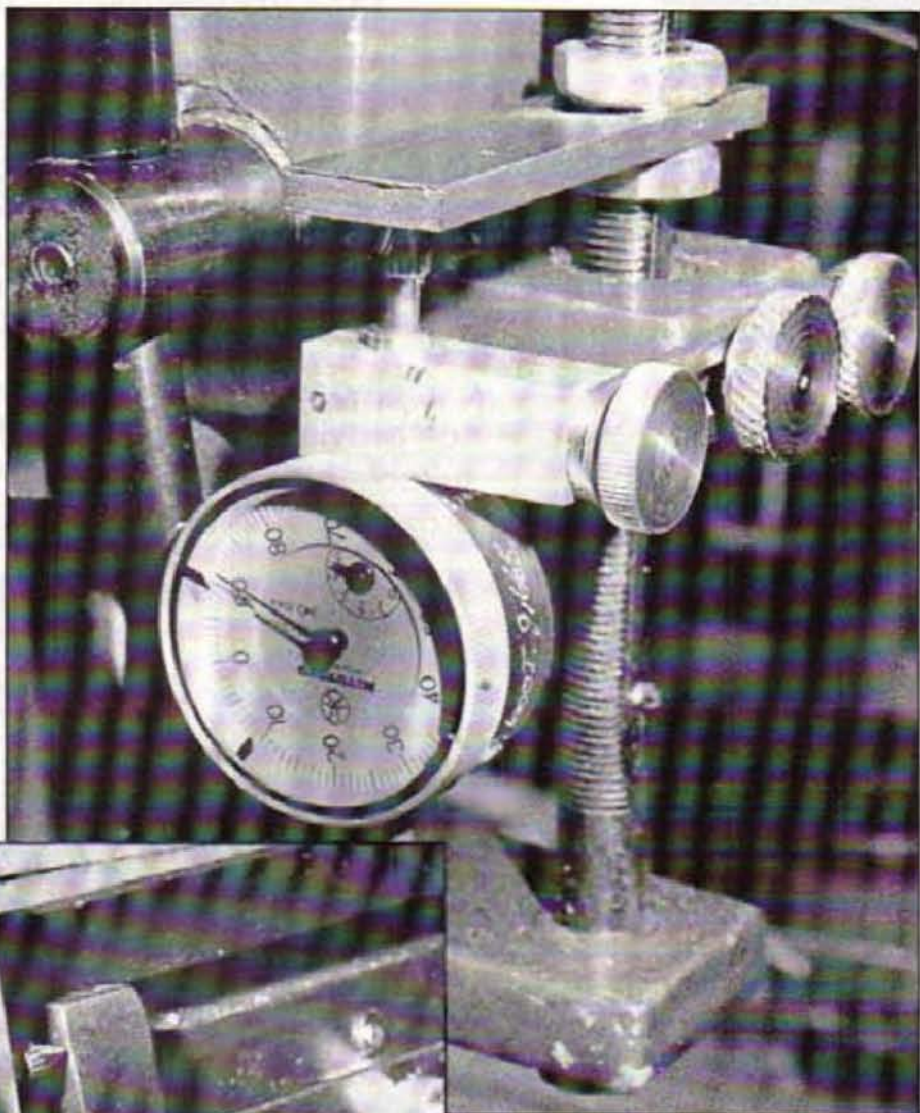
GETTING IT RIGHT!

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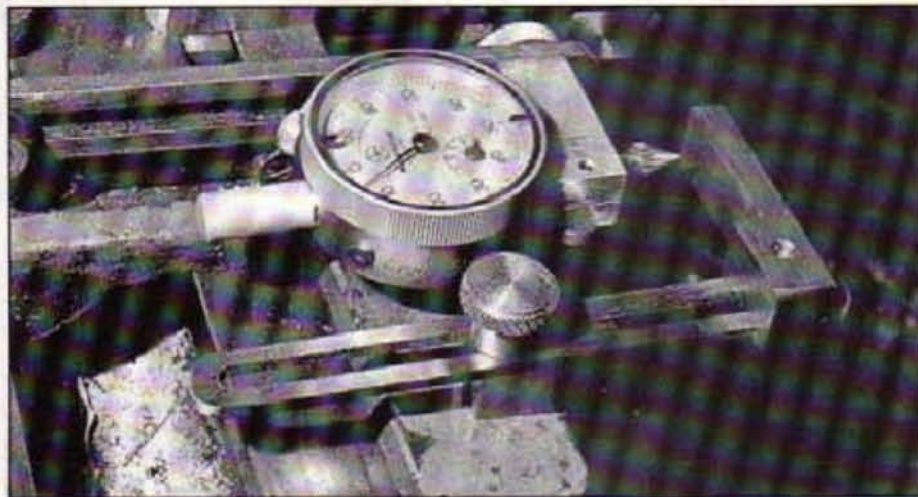
tee slots can be used for the moving section. If stops are provided on the machine these too are frequently easily adaptable. Small holes drilled and tapped in the stops can be used to hold the brackets and prove to be an easily adjustable point of fixing.

The down feed

The down feed on the milling machine is the place where the system really is worth its weight in gold. Unless one has a very high-class machine, it is very difficult to bring the feed down with the accuracy required. Here again the stops can be pressed into use. The photograph shows how a couple of small screws (2BA) have been fitted to the head casting and a bracket put on these which adjusts sideways. A simple open-ended slotted piece of steel fits in between the lock nuts of the stop. The slot in the steel must be slightly off centre to get the required clearance, but otherwise it is all quite straightforward.



Top right, an attachment fitted to the milling machine down feed; two 2BA holes had to be made in the column to hold it in position but this did not weaken the machine. This photograph (above) shows the use of the existing milling machine stop for measuring purposes; an alternative would be to fabricate a device. Below, an attachment fitted to the lathe cross slide.



Backlash

One other advantage of the system is the elimination of worries over backlash. In theory, to get over this problem we take the handle back beyond the required point and read our dial when the backlash is felt to have picked up. In practice, it is very difficult to know at what point this actually happens. Because the dial gauge and pad are fitted to a moving and a fixed part, backlash is of no consequence whatever. Only when the moving component is in operation does the dial give the reading. One slight problem that can arise is dirt and swarf getting on the dial gauge; it will probably do no harm, but it is as well to cover it with a plastic bag during operations. Some readers will, no doubt, go further and devise proper covers of perspex or similar material.

Other uses

The brackets devised for fixing the gauge in position can often also be used as part of the setting-up equipment which avoids the need to put a magnetic stand on the machine; this will invariably collect swarf that it was thought was not there. The large knurled bolts make it quick and easy to fix the gauge in position. Usually only about three brackets are needed to cover the workshop machinery and four or five slotted lengths. Of course, the idea invites being added to and, no doubt, a collection will be built up as time goes by.

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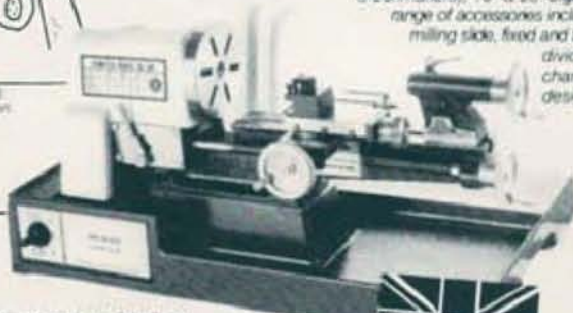
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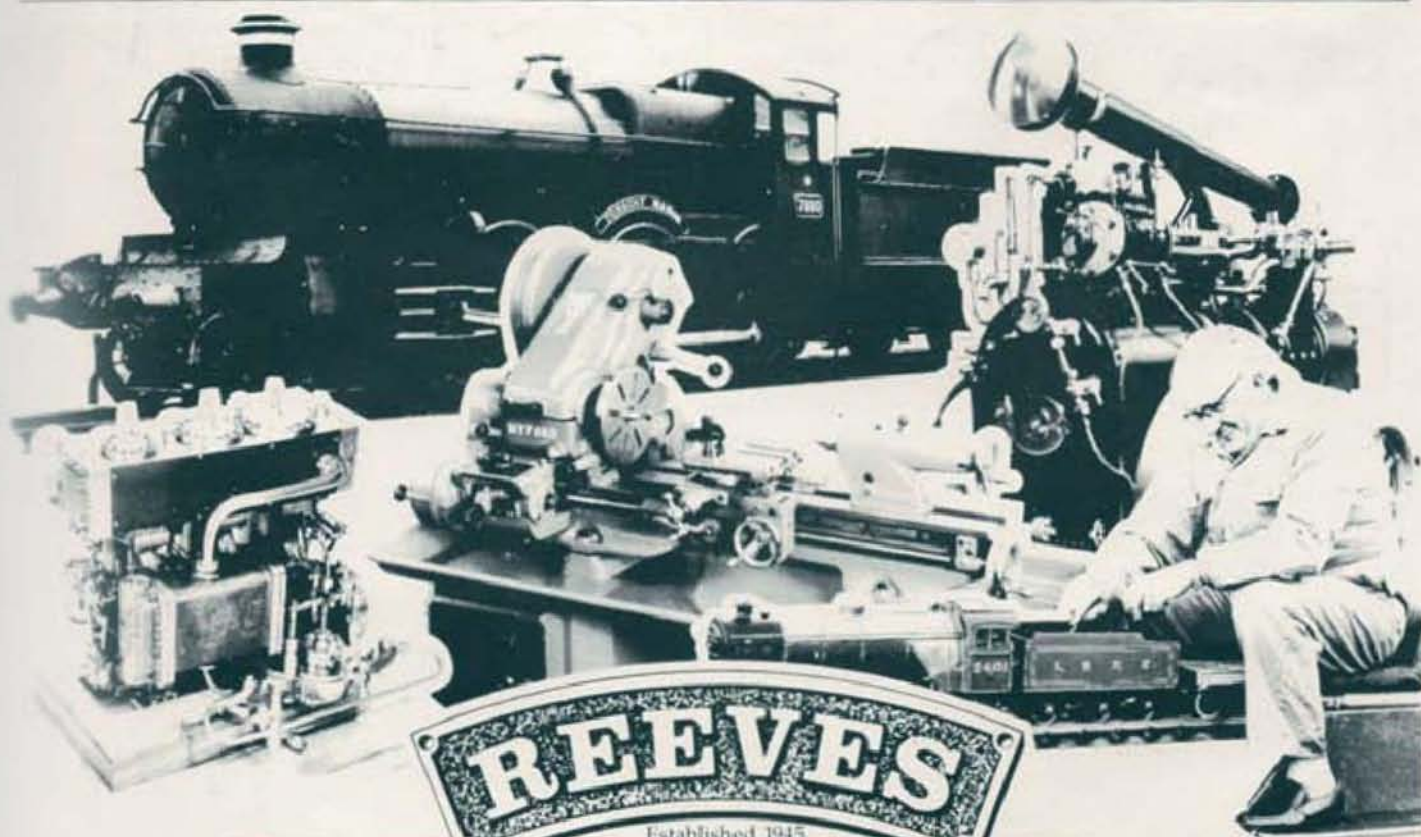
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